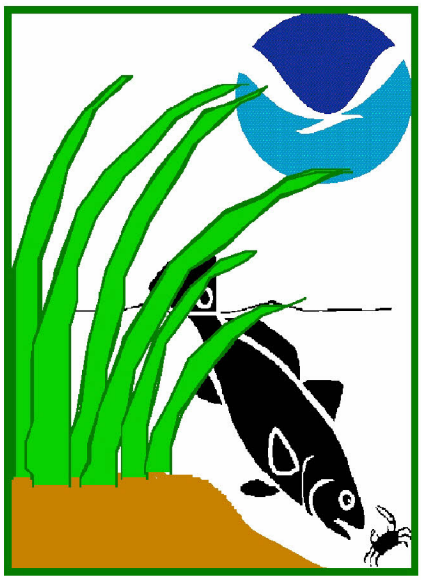
CDMO NERR SWMP
DATA MANAGEMENT MANUAL

Version 6.3
(February 2010)



National Estuarine Research Reserve System

Centralized Data Management Office

In support of the

NERR System-wide Monitoring Program

NOAA National Estuarine Research Reserve
Centralized Data Management Office
c/o Belle W. Baruch Institute for Marine and Coastal Sciences
Baruch Marine Laboratory
University of South Carolina
22 Hobcaw Road
Georgetown, SC 29440

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Written by
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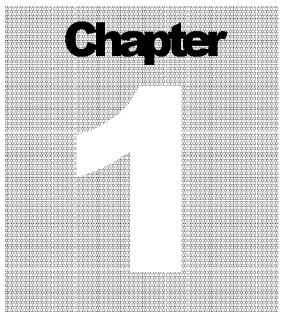

Background

The purpose of this data management manual is to:

(1) Provide information and protocols in order to manage data generated by the National Estuarine Research Reserve (NERR) System-wide Monitoring Program (SWMP) in a standardized manner, and
(2) Provide technical information in order to interact with the Centralized Data Management Office (CDMO) On-line Data and Information Server (ODIS).

This data management manual is written for the NERR SWMP technicians and research coordinators, and is designed to assist those with limited exposure to data management, computer hardware and software, and telecommunications.

The manual is divided into ten parts covering the following topics:

(1) Chapter 1 contains background information on the NERR, the SWMP, the CDMO, database ownership policies and preparation for data management.
(2) Chapter 2 contains information on the materials needed to conduct SWMP including required equipment, computers, software and software installation instructions.
(3) Chapter 3 contains standard operating procedures for the water quality monitoring program.
(4) Chapter 4 contains procedures for the management of water quality data from acquisition to submission.
(5) Chapter 5 contains data review and editing protocols for the water quality monitoring program.
(6) Chapter 6 contains standard operating procedures for the meteorological monitoring program.
(7) Chapter 7 contains procedures for the management of meteorological data from acquisition to submission.
(8) Chapter 8 contains data review and editing protocols for the meteorological monitoring program.
(9) Chapter 9 contains standard operating procedures for the nutrient monitoring program.
(10) Chapter 10 contains procedures for the management of nutrient data from acquisition to submission.
(11) Chapter 11 contains a list of references used in this manual.
(12) The Appendix contains Internet addresses and NERR site codes.

Background of the National Estuarine Research Reserve

An increased awareness of the degradation of estuaries, fueled by the environmental movement of the 1960s and 1970s, resulted in the passage of legislation aimed at protecting estuarine ecosystems. A landmark piece of legislation enacted by Congress was the Coastal Zone Management Act (CZMA) of 1972. Section 315 of the CZMA authorized the establishment of "estuarine sanctuaries" to augment the federal coastal zone management program, which is dedicated to comprehensive, sustainable management of the nation's coasts. These sanctuaries, administered by the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, were to serve as natural field laboratories for the conduct of research related to coastal management. As defined by the Act, "These sanctuaries were to be research areas which could include any or all of an estuary, adjoining transitional areas and adjacent uplands, set aside to provide scientists and students the opportunity to examine over a period of time the ecological relationships within the area."

The system of estuarine sanctuaries was intended to represent different types of estuaries and the many biogeographic regions across the nation. The intent of the program was to establish a state-federal partnership that would promote stewardship of threatened coastal resources. The first estuarine sanctuary was designated in 1974 at South Slough, Oregon. Initially, states used federal funds primarily for land acquisition. Following several amendments related primarily to funding level, Congress re-authorized the CZMA in 1985, and changed the name of the National Estuarine Sanctuary Program to the National Estuarine Research Reserve System. As a result, program emphasis shifted to research, education, and public awareness, with emphasis on coordination among the sites.

Since 1974, on average, one new reserve has been designated per year. Currently, 27 reserves in 21 states and territories protect over 1 million acres of estuarine waters, wetlands and uplands. NOAA establishes standards for designating and operating the reserves; provides base funding for operation, research and education; sponsors a graduate fellowship program; and integrates information from individual reserves to support decision-making at the national level. The role of the coastal states that manage reserves is to gather scientific information through research and long-term monitoring programs within the reserve and its watershed, to provide scientific information to target audiences, to address resource management needs, and to promote stewardship of resources.

Historically, research and monitoring efforts have varied widely among reserves as a result of the amount of funding available to each reserve and also from the type of baseline scientific data available for a given system. Some reserves had a long history of scientific research prior to designation. Other reserves had very little existing scientific information about their site, so their research program entailed collecting baseline data on biotic resources and basic water quality. Regardless of the approach, data were being collected to characterize the reserves' ecology and would ultimately become part of a published ecological characterization of each site.

The reserve system provides an ideal vehicle to establish a nationally coordinated monitoring program. The estuarine reserve system was built on a foundation of ongoing partnerships among state and federal agencies and community groups. Essentially, the reserves already have a framework in place that links stewardship, public education and scientific research.

Because estuarine ecosystems are naturally highly variable and complex systems with variations occurring over many spatial and temporal scales, distinguishing variability due to natural events from those due to anthropogenic factors has proven to be difficult. In addition to the need for more research to show cause

and affect relationships, long-term monitoring programs are essential to identify the temporal and spatial scales of natural variability that characterize estuaries.

Despite the importance of the coastal region to the Nation's economy and well being, and the high potential for human use and for natural events to adversely impact the resources and coastal ecosystems, little is known about the status and trends of critical environmental variables in coastal regions. There are currently no nationally consistent, comprehensive monitoring programs to provide information necessary for effective management of the nation's estuaries. For example, national monitoring of conditions leading to eutrophication does not exist, even though many of our estuaries have oxygen depletion problems.

With 27 sites in the United States and Puerto Rico that reflect the diverse coastal biogeographic regions of the Nation, the National Estuarine Research Reserve System is ideally suited to implement a long-term trend monitoring program to address estuarine management issues. (Ross 2002)

See http://nerrs.noaa.gov/welcome.html.

Background of the System-wide Monitoring Program

Long-term environmental monitoring is both a scientific and management imperative for effective coastal resource research, management, and education. The establishment of long-term monitoring programs enables baseline studies, trend analyses, and impact assessment of both natural and anthropomorphic phenomenon (National Research Council 1994). Advances in information technology are rapidly changing the way that government and research agencies can assimilate, manage, disseminate, and share the data and information pertinent to long-term monitoring programs (Federal Geographic Data Committee 1994). The technology revolution is providing organizations the opportunity to collect and integrate digital data independently while providing cost-effective mechanisms for site and intersite exchange of data and information.

The National Oceanographic and Atmospheric Administration (NOAA) National Estuarine Research Reserve System (NERRS) recognized the importance of both long-term monitoring programs and data and information dissemination and therefore, implemented the NERR System-wide Monitoring Program (SWMP). (Porter et al. 1994)

Research objectives

Resultant from a February 1994 workshop held at the North Inlet-Winyah Bay National Estuarine Research Reserve to discuss the design of a national monitoring program, it was agreed that the specific goal of the System-wide Monitoring Program is:

"to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site specific coastal zone management."

This comprehensive program consists of three phased components:

(1) **Abiotic Factors** including atmospheric, water quality (nutrients, contaminants, etc.), and physical parameters (salinity, tidal range, groundwater, freshwater inflow, bathymetry, etc.);
(2) **Biological Monitoring** including biodiversity habitat and population characteristics; and
(3) **Watershed and Land Use Classifications** including changes in consumptive and non-consumptive uses.

Research methods

Water Quality - At all NERR sites, four locations within or adjacent to the **Reserve** will be monitored. The following parameters will be collected every 15-minutes: water temperature, specific conductivity, salinity, percent saturation, dissolved oxygen concentration, water depth, pH and turbidity. All water quality datasondes (YSI) will be deployed at a known distance from the bottom, so that the sonde probes are between 0.25 and 0.5 meters above the substrate at each site.

Meteorological – At all NERR sites, at least one location within or adjacent to the **Reserve** will be monitored allowing for local weather events to be related to monitored water quality conditions. The following parameters will be measured: air temperature, relative humidity, wind speed and direction, rainfall, barometric pressure, and photosynthetically active radiation.

Nutrient – At all NERR sites, at least the four water quality datasonde locations within or adjacent to the **Reserve** will be monitored. The following parameters will be collected on a monthly basis at all four locations and over a full tidal cycle (or 24 hours, whichever is greater) at one location: ammonium

(NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-), orthophosphate (PO_4^-) and chlorophyll a. If a reserve can show that NO_2^- is a minor component relative to NO_3^-, then NO_3^- + NO_2^- can be substituted for individual analysis.

See http://nerrs.noaa.gov/Monitoring/welcome.html.

Background of the Centralized Data Management Office

The Centralized Data Management Office (CDMO) was established in support of the System-wide Monitoring Program. The purpose of the CDMO, housed at the North Inlet-Winyah Bay, South Carolina NERR, is the development, implementation, and management of the basic infrastructure and data protocol to support the assimilation and exchange of data, metadata, and educational and coastal management information within the framework of NERR sites, state coastal zone management (CZM) programs, and The National Oceanographic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (NOAA/OCRM), as well as other state- and federally-funded education, monitoring, and research programs.

Technical support

The CDMO staff is committed to providing NERR sites with the necessary service and support to facilitate the exchange of data, metadata, and other information resulting from this long-term project.

Technical Support is available:

(1) Telephone support is available Monday through Friday from 8:30 a.m. to 4:30 p.m. Eastern Time by calling the following numbers **(843) 546-6219** or **(843) 546-3623**.
(2) For software/hardware/telecommunications problems, ask for the CDMO System Administrator.
(3) General problems or questions can be e-mailed to:
The CDMO data management team at **cdmo@belle.baruch.sc.edu** or to the CDMO support team at **cdmosupport@belle.baruch.sc.edu**.
(4) Fax problems or questions to the CDMO at **(843) 545-7231**.
(5) Site visits to an individual NERR site can be arranged if the site funds the trip. However, CDMO representatives are often at NERR sites during NERRS related meetings. If a NERRS meeting is being held at your site, you may be able to arrange technical support during that time. Call the CDMO to make arrangements.

See http://cdmo.baruch.sc.edu.

NERR database ownership and dissemination policies[1]

The following policy was developed by the SWMP Data Management Committee to address concerns of data ownership, liability and dissemination,

> The protocols for data ownership, custodial liability, data submission, and data access have been developed in accordance with known current Federal guidelines and/or standards for environmental data collection activities.

Data liability policy

The data sets are only as good as the quality assurance and quality control (QA/QC) procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use or misuse in any further analyses or comparisons. The Federal Government does not assume liability to the Recipient or third persons, nor will the Federal Government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data set.

Data dissemination policy

Data collected in conjunction with the National Estuarine Research Reserve System (NERRS) System-wide Monitoring Program is considered public information. The principal investigators (PI's) responsible for collecting data at each NERR site must process the data using Estuarine Reserves Division (ERD) approved quality assurance and quality control (QA/QC) protocols. The PI transmits the QA/QC processed data to ERD or an ERD approved Centralized Data Management Office (CDMO) in accordance with the standard rules for application to oceanographic data sets (NOAA Administrative Order 216-101). The submission schedule determined by the CDMO assumes an adequate and uninterrupted funding for the monitoring effort at each site, therefore the data processing and the transmission timetable may be adjusted accordingly.

An awardee may own a copyright on the publication of the processed data developed or bought under a Federal assistance award. The Federal awarding agency reserves a royalty-free, nonexclusive, and irrevocable license to reproduce, publish, or otherwise use, and to authorize others to use, for Federal government purposes, the copyright in any work developed under an award, or any rights of copyright purchased by an awardee with Federal assistance support (15 C.F.R. 24.34). Any such publication will include a notice identifying the award and recognizing the license rights of the government under this clause. This paragraph will have no force and effect for the processed data not published by the recipient.

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM-supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under

[1] Excerpts from these paragraphs will be published on all metadata disseminated from the CDMO. These paragraphs, in their entirety, will accompany all data requests made through the CDMO.

an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration.

Metadata dissemination policy

This data set was collected under the National Oceanic and Atmospheric Administration's (NOAA) National Estuarine Research Reserve System (NERRS) System-wide Monitoring Program. The principal investigator (PI) listed on the enclosed metadata reporting statement retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be fully acknowledged in any subsequent publications in which any part of this data set is used. Pursuant to NOAA Administrative Special Award Condition #5, manuscripts resulting from this NOAA/Office of Ocean and Coastal Resource Management-supported research and data collection effort that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration.

Policy for data submission to the CDMO

Under no circumstances will a data file, data set, data layer, or database be accepted by or made available via the CDMO without appropriate supporting metadata.

Data citation policy

This data was collected under NOAA's National Estuarine Research Reserve's (NERR) System-wide Monitoring Program. The principal investigator (PI) listed on the individual NERR site's metadata page retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected should be fully acknowledged in any subsequent publications in which any part of these data are used.

Data citation

National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, National Estuarine Research Reserve System-wide Monitoring Program. 2008. Centralized Data Management Office, Baruch Marine Field Lab, University of South Carolina http://cdmo.baruch.sc.edu.

The principal investigator (PI) retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM-supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration.

Preparation for data management

Computer preparation and maintenance

It is recommended that the computer designated for data management have **two hard drives**. The first hard drive should be designated as the **primary hard drive (C:\)** that should contain all the **operating system and program files** only. The second hard drive ideally should be removable and designated as the **secondary hard drive (D:\)** that should store **data files** only. By keeping the system and program files on a separate hard drive, the data on the secondary hard drive will be protected in the event that the primary hard drive fails or becomes infected with a virus. Also, the secondary hard drive can be removed in the event of an evacuation in order to preserve the data. However, if the computer designated for data management does not have two hard drives, all data will have to be placed on the primary hard drive making the need to back up the data to CD, DVD, or another computer even more critical.

The data should be protected further by: keeping the computer virus protection up to date; using the Windows Disk Cleanup, Error-Checking Scan Disk and Disk Defragmenter utilities on a monthly basis to find and correct any errors on the disk; archiving the data onto CD-R/W, DVD-R/W, an external hard drive, or the network at your site; securing your computer behind firewalls; applying password and log in protection to your computer; and finally, using an uninterruptible power supply to provide enough time for the user to properly shut down the computer in the event of power loss or a power surge. Contact your network administrator for assistance with these issues.

Data archival

Two important terms any computer user should be familiar with are:

Backup: To create a temporary copy of the data to another media or location. Backups should be conducted frequently (daily) and to a separate computer, hard drive, CD or DVD and is usually overwritten with the next backup.

Archive: To create a permanent copy of the data to a tape, CD or DVD that is write protected and stored in a secure location (fireproof cabinet). Data should be archived on a regular basis (monthly).

Data archival is the most important part of data management and must be made top priority to maintain the security and integrity of the data from hard-drive failures, virus infections, or human error. Benefits of conducting regular data backups and archival are:

(1) If the data gets corrupted or incorrectly edited, the user can load the data from the previous back up to correct the problem.
(2) If the computer becomes infected with a virus or experiences hardware or software failure, the user can load the data from the previous back up to correct the problem.
(3) If it was discovered that the data were inadvertently changed a number of weeks or months ago, the data backups would be useless; in this case, the user can go to the last data archive to retrieve the correct data.

It is recommended to make multiple backups and archives and store them in different locations (on-site and off-site) for further protection:

(1) In a separate folder on your secondary hard drive,
(2) Onto CD or DVD, and
(3) Onto a separate computer or a network.

All data should be backed up and archived on a regular basis to include raw files, working files, edited files, metadata files, database files, etc. Each is an essential component for proper QAQC.

The CDMO also recommends that efforts be made to protect and archive all print media (paper, notebooks, field books, etc.). Print media should be stored in fireproof cabinets to protect it from heat during a fire. It is also recommended that important print media be scanned into the computer to create a digital image and archived on digital media.

The CDMO recommends the use of third party software specially designed to backup digital media (electronic files). This software should give the user the option of scheduling backups as well as the ability to backup over a network, to CD-R/W, to DVD-R/W or to tape. Backups can also be done manually by copying and pasting specific files; however this requires diligence and MUST be done before any changes are made to a database. It is therefore recommended to use a software program specifically designed for this task. The digital storage media (hard-drive, CD, DVD, tapes, etc.) can then be stored in a fireproof transformer inside of a fireproof file cabinet to protect it from heat and humidity in the event of a fire.

Overview of data management

Effective with the submission of 2007 SWMP water quality (WQ) and meteorological (MET) data[2], the CDMO's data submission process was enhanced to improve the data delivery and availability of the NERRS SWMP data to the public. All WQ and MET data now go through an automated primary quality control and quality assurance check (QAQC), and are posted as provisional[3] data on the CDMO online data information server (ODIS) http://cdmo.baruch.sc.edu. After primary QAQC, the data are emailed back to the Reserve with QAQC flags imbedded into the dataset to identify erroneous and suspect data. The Reserve then conducts secondary QAQC using tools developed by the CDMO and submits those files to the CDMO on a quarterly basis as provisional plus[4] data. The CDMO performs tertiary QAQC on an annual basis after all supporting documentation is submitted. Once the data have been authenticated, the data become authoritative[5] on the CDMO ODIS.

The near real time NERRS SWMP data that are transmitted to the CDMO also go through automated primary data QAQC and are immediately made available as provisional data on the CDMO ODIS. Occasionally some of the data received are missing or erroneous due to satellite transmission errors[6] when correct data were recorded and exist in the instrument itself. **This is why it is strongly recommended that Reserves download the raw files from the YSI at the telemetered stations and use the data submission tool to submit it to the CDMO**. The near real time data are then replaced by provisional plus data, and finally authoritative data, as detailed above.

Reserves will use the tools developed by the CDMO to conduct secondary QAQC on the nutrient (NUT) data once it has been acquired from the analytical laboratory and validated. Nutrient data will be submitted to the CDMO on an annual basis via the CDMO ftp site (ftp://cdmo.baruch.sc.edu) for submission. The CDMO then performs tertiary QAQC after all supporting documentation is submitted. Once the data have been authenticated, the data become authoritative on the CDMO ODIS.

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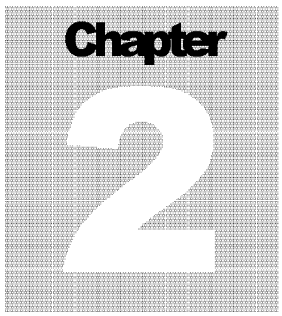
[2] Note that nutrient (NUT) data are not part of the enhanced data submission process at this time.
[3] Provisional data have not been edited or reviewed and will only exist until being replaced with the final authoritative data that have been through tertiary review by the CDMO.
[4] Provisional plus data have been through primary and secondary review and are awaiting final tertiary review by the CDMO.
[5] Authoritative data refer to data that have gone through final tertiary review at the CDMO.
[6] Transmission errors are due to a disconnection between the YSI and transmitter and transmitter calculation errors.



Materials

General information

The Materials chapter is divided into four parts: 1) a description of the various equipment needed to conduct SWMP and perform data management, 2) a description of the minimum computer requirements needed to perform data management and connect to the various monitoring instruments, 3) a description of the various software needed to perform data management and installation instructions, and 4) a description of the various software needed to access and utilize the CDMO Online Data Information Server (ODIS), CDMO Content Management Site (CMS) and FTP server and necessary software configurations.

Reminders:

1) It is essential to virus check the files before sending them to the CDMO. Appendix A contains the Internet addresses for virus protection software.

2) All NERR sites need to contact the CDMO for the current account and password to use before logging into the CDMO FTP server or the CDMO Content Management Site.

Equipment requirements to conduct SWMP

Equipment recommendations

Below is a list of equipment requirements needed to perform the NERR SWMP water quality, meteorological and nutrient monitoring program:

(1) **YSI 6600 datasondes or EDS datasondes** should be deployed at four long-term monitoring locations at each NERR and collect water temperature, specific conductivity, salinity, percent saturation, dissolved oxygen concentration, depth, pH and turbidity.
(2) **Campbell Scientific CR1000 meteorological station** should be set up at one long term monitoring location at each NERR to collect air temperature, relative humidity, barometric pressure, wind speed, wind direction, precipitation and photosynthetically active radiation.
(3) **ISCO automatic portable water sampler** should be deployed at one long term monitoring location at each NERR.

For more information regarding SWMP (equipment requirements, monitoring guidelines, deployment plans, etc.) refer to the Information Package for New Research Coordinators within the National Estuarine Research Reserve, April 2002, for a list of important documents. This document can be obtained from the CDMO FTP Server or the CDMO Content Management Site.

Computer requirements to conduct SWMP

Computer recommendations

The **recommended minimum** IBM PC compatible computer configuration needed to perform the NERR SWMP **data management** should consist of:

(1) **Computer hardware** with at least a 750mHz processor, 256MB of memory, 20GB hard drive, one removable media (20GB hard drive for data storage), CD-RW or DVD-RW for data backup, 3 ½ inch floppy disk drive, modem and/or Ethernet card to backup to network and connect to CDMO ODIS or FTP server, 15 inch CRT monitor, and keyboard and mouse;
(2) **Computer software** with at least Microsoft Windows 2000, Microsoft Office 2000, Internet Explorer, and McAfee VirusScan or Norton Antivirus.

The **recommended minimum** IBM PC compatible computer configuration needed to **interface with** the YSI 6600 datasonde and the Campbell Scientific CR10X should consist of:

(1) **Computer hardware** with at least a 450mHz processor, 128MB of memory, 5GB hard drive, CD-RW for data backup, 3 ½ inch floppy disk drive, modem and/or Ethernet card to back up to network and connect to CDMO FTP server, multiple serial (com) ports to connect to YSI and storage module, 15 inch CRT monitor, and keyboard and mouse;
(2) **Computer software** with at least Microsoft Windows 2000, EcoWatch from YSI, PC208W or LoggerNet (from Campbell Scientific), and McAfee VirusScan or Norton Antivirus.

For more information regarding hardware or software requirements needed to interface with the YSI Inc. datasondes and the Campbell Scientific CR1000, refer to the individual operation manuals or the list of Internet addresses in **Appendix A** to link directly to the vendor web site.

Software requirements to conduct SWMP

Software recommendations

Below is a list of the software needed to perform the NERR SWMP water quality, meteorological and nutrient **data management**:

1) An internet browser such as **Internet Explorer**, or **Mozilla Firefox** to submit data to the CDMO and interface with the CDMO FTP, CMS and ODIS.
2) **Microsoft Excel,** a spreadsheet program, will allow the user to perform secondary QAQC of the NERR SWMP data. Excel should be used for data editing and complex graphing.
3) **Microsoft Word,** a word processing program, will allow the user to create metadata (data documentation). Excel metadata sheets can easily be copied into Word.

For information regarding software needed to interface with the YSI Inc. datasondes and the Campbell Scientific CR1000, refer to the individual operation manuals or the list of Internet addresses in **Appendix A** to link directly to the vendor web site.

Installing the NERRQAQC and NutrientQAQC macros

Follow the instructions below to install the NERRQAQC and NutrientQAQC macros on your computer.

1) Retrieve the **NERRQAQC.XLS** and **NutrientQAQC.XLS** macros from the CDMO FTP server at ftp://ftpcdmo.baruch.sc.edu or from the CDMO Content Management Site (CMS) at http://cdmo.baruch.sc.edu/php_nuke/index.php and copy it to your local computer. Contact the CDMO support team at cdmosupport@belle.baruch.sc.edu to obtain your username and password if you do not have it.

2) Move the **NERRQAQC.XLS** macro into the Microsoft Office XLSTART directory on your local computer to the following location: **Program Files>Microsoft Office>Office>XLSTART**. This will cause Microsoft Excel to launch the macro each time Excel is started. However, if you prefer to open the macro manually, leave the XLSTART directory empty and open the macro only as needed.

3) Once Excel is opened, you will see two command bars at the top of the Excel window. One is the **NERRQAQC macro command bar** and the second is the **NutrientQAQC macro command bar**. From these command bars, you can open the primary QAQC'd data files from the CDMO, perform QAQC checks, insert QAQC flags and codes into the dataset and export the final data to the CDMO.

Figure 1. NERRQAQC command bar

Figure 2. NutrientQAQC command bar

Software requirements to access the CDMO FTP, CMS and ODIS

The purpose of the CDMO FTP, CMS and ODIS is to facilitate the exchange of data management materials, data and metadata developed in conjunction with the NERR System-wide Monitoring Program and related projects.

Software recommendations

Internet browsers, such as **Mozilla Firefox** or **Internet Explorer,** can be used to interface with the CDMO FTP, CMS or ODIS. Or you can create a new network place for the FTP, CMS and ODIS using the Windows **My Network Places**. FTP clients, such as WS_FTP, can be used to interface with the CDMO FTP server only.

CDMO FTP directory structure

Each **Reserve** has its own directory on the CDMO FTP server containing these three subdirectories, one for each data type: **water quality, meteorological** and **nutrients.** Within these three data type directories are three subdirectories: **data, metadata** and a directory for the digital field and calibration logs. Within the **data** directory there are two subdirectories: one for **raw** data and the other for **edited** data. Under each edited and raw directory are directories for the current year of data.

As raw data are uploaded to the CDMO via the data submission webpage, it is automatically placed in the corresponding Reserve and monitoring program's raw data directory.

IMPORTANT: Authoritative historical data are purged from the CDMO FTP server the year after all data reviews are complete. The data are archived in numerous formats, media and locations including deep archival at the NOAA National Oceanographic Data Center (http://www.nodc.noaa.gov/).

For example, the NIW NERR directory structure is as follows:

/North Inlet Winyah Bay

/water quality

/data

/edited

/current year of data

/raw

/ current year of data

/metadata

/digital logs

/meteorological

/data

/edited

/ current year of data

/raw

/ current year of data

/metadata

/digital logs

/nutrients

/data

/edited

/ current year of data

/raw

/ current year of data

/metadata

To put the **data** into the correct directory, move from the root directory into the **Reserve** directory (parent directory), and then into the **water quality**, **meteorological,** or **nutrients** directory. Double-click the **data** directory then the **edited** directory and finally the appropriate year folder to transfer the edited files into. You do not have to transfer any raw data files for water quality or meteorological data because they are automatically transferred to the **data/raw** directory during the data submission process. You will need to manually transfer raw nutrient data in whatever form you receive it.

For the metadata, move from the root directory into the **Reserve** directory, and then into the **metadata** folder in the **water quality**, **meteorological,** or **nutrients** directory.

Transferring files to the CDMO FTP server using an Internet browser

1) Open Internet Explorer and type in the CDMO FTP address: ftp://cdmo.baruch.sc.edu in the address box and click OK. The following window will open.

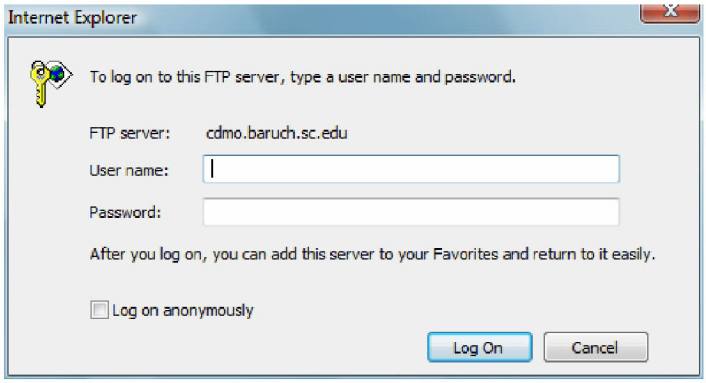


Figure 3. FTP login window.

2) With the **Login As** window open, you will need to type in your User Name (User ID) in the **User Name** box. Type your password in the **Password** box. Next check the **Save Password** box, and then click **Login** to connect to the CDMO FTP server. Contact the CDMO support team at cdmosupport@belle.baruch.sc.edu for your user name and password if you do not have it.

IMPORTANT: Please **DO NOT SAVE THE PASSWORD** if this is a public computer/terminal in order to protect the data and the CDMO FTP server.

3) Once you have successfully logged onto the CDMO FTP server, the following window will open:

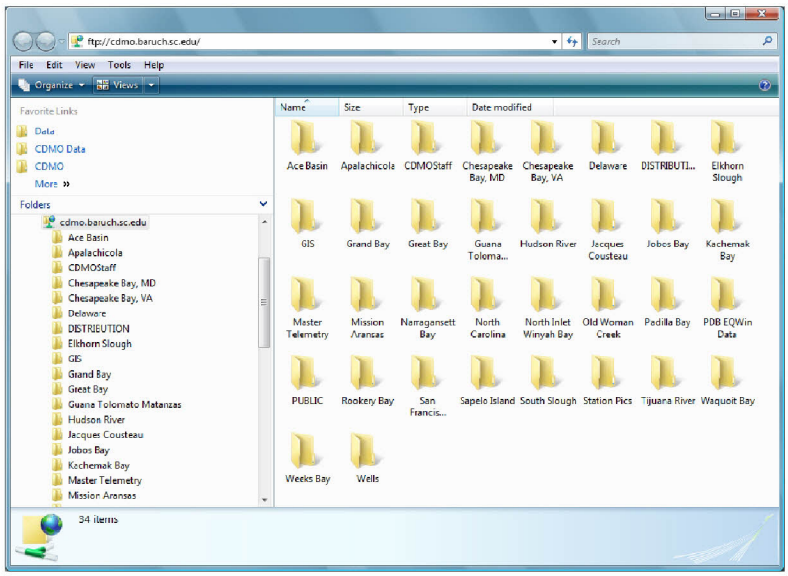


Figure 4. CDMO FTP server window.

a) **IMPORTANT:** Note that if using Internet Explorer 7 or 8, in order to view this FTP site in Windows Explorer, click **Page**, and then click **Open FTP Site in Windows Explorer**.

4) Reserves have access to their own directory as well as to the **DISTRIBUTION** and **PUBLIC** directories. The DISTRIBUTION directory contains software, manuals, documentation and other materials the CDMO wishes to distribute to the NERR community. Access to all other directories is denied in order to secure the data.

5) This FTP interface has a windows environment, therefore the user can simply double-click their folder and proceed to drag and drop files into it or use the copy and paste function in order to transfer files to and from the FTP server. Be aware the transfer rate using an Internet browser is slower than when using the WS_FTP program.

Connecting to the CDMO ODIS with an Internet browser

If this is the first time you are visiting the CDMO ODIS (http://cdmo.baruch.sc.edu), you will want to bookmark it for future reference.

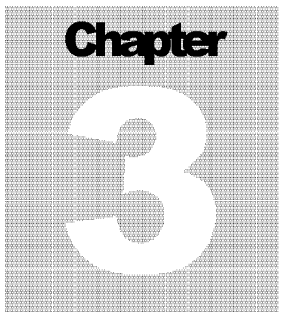
Figure 5. The CDMO home page.

The most important function of the CDMO ODIS is to disseminate the NERR SWMP data and metadata. Through the use of the CDMO ODIS, users will have access to the background and goals of the CDMO, NERR SWMP standard operating procedures and data management manual, contact information for the

CDMO and most importantly, access to the data and metadata through the use of clickable maps or virtual directories.

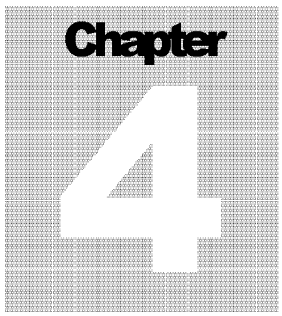
The following are descriptions of the navigational menu on the CDMO ODIS.

(1) The **Home** menu will link to the main CDMO web page http://cdmo.baruch.sc.edu.
(2) The **About CDMO** menu contains an **Overview** of the CDMO, a directory listing of **CDMO Staff**, and a listing of the CDMO's current **Activities**.
(3) The **About Data** menu contains information on **Available Data** for query and download**,** the **CDMO** Data Management **Manual**, the NERR **Data Policy**, **Data Citation**, **Data QA/QC**, **Parameters** collected, and associated **Metadata**.
(4) The **Get Data/Download** menu will link to the **Download/View/Graph** function of the CDMO ODIS where you can **Export Data** and **Yearly Files**. Users can also download **GIS Files** in the form of **Google Map** or **Shapefiles**.
(5) The **Web Services** menu contains information on how to obtain real-time data from the CDMO.
(6) The **Contact CDMO** menu contains a form users can fill out to contact the CDMO directly.



Standard Operating Procedures: Water Quality Monitoring

(INSERT YSI 6-SERIES MULTI-PARAMETER WATER QUALITY MONITORING SOP HERE)



Water Quality Data Management Procedures

The Water Quality Data Management Procedures chapter describes the collection, error checking, review, editing, graphing and export of the data as well as the creation of the associated metadata.

Data submission timelines

Raw data files must be submitted to CDMO for automated primary QAQC and provisionary posting within one week of data retrieval from the instrument.

Primary QAQC'd data files must go through secondary QAQC at the Reserve and be submitted to CDMO on a quarterly basis. These files will be posted as provisional plus data.

Primary QAQC data collected during months:	Must go through secondary QAQC and be submitted to the CDMO by:
January - March	May 1st
April - June	August 1st
July - September	November 1st
October - December	February 1st

Table 1. Secondary QAQC submission

Yearly secondary QAQC'd files must be submitted to CDMO for final review by March 15 of the following year. Reserves will append their quarterly data submissions into yearly data files, which will replace the quarterly files on the CDMO ODIS and again be posted as provisional plus data. In addition, the yearly metadata file, raw .DAT files, and digital calibration and field logs are required for final submission. After the CDMO performs the final tertiary QAQC, the data will be posted as authoritative.

IMPORTANT: Notify the CDMO of your quarterly and yearly secondary QAQC'd data submissions. This will enable us to verify that your submission is complete *before* the deadline.

Overview of data collection

All water quality data should be collected in 15-minute intervals at a known, fixed distance from the bottom (between 0.25 and 0.5 meters above the substrate). The YSI datasonde must be configured to collect the following required SWMP parameters. The optional SWMP supported parameter may also be collected and submitted to the CDMO, but is not required. The data order and measurement units of the YSI datasonde output can be changed in the **Main Menu** section of the PC6000 or EcoWatch software in **Report Setup**. See the YSI manual for these features.

Parameter	Short Name	Units	Format
(1) Date	**Date**	**mm/dd/yyyy**	**mm/dd/yyyy**
(2) Time	**Time**	**hh:mm:ss**	**hh:mm:ss**
(3) Water Temperature	**Temp**	**°C**	**00.0**
(4) Specific Conductivity	**SpCond**	**mS/cm**	**000.00**
(5) Salinity	**Sal**	**ppt**	**00.0**
(6) Dissolved Oxygen	**DO_pct**	**%**	**000.0**
(7) Dissolved Oxygen	**DO_mgl**	**mg/L**	**00.0**
(8) Shallow Depth	**Depth**	**m**	**0.00**
	Level*	**m**	**0.00**
(9) pH	**pH**	**units**	**00.0**
(10) Turbidity	**Turb**	**NTU**	**0000**
Optional Parameter:			
(11) Chlorophyll Fluorescence**	**ChlFluor**	**ug/L**	**000.0**

*Level is reported in place of Depth if vertical control has been established at the sample station.

**Chlorophyll Fluorescence is an optional SWMP supported parameter. It is not required; but may be submitted to the CDMO and posted on the CDMO ODIS. If a Reserve does choose to submit an optional SWMP supported parameter, it must go through all SWMP QAQC and data management procedures.

Note: The short name will replace the default YSI headers when the data go through primary QAQC to maintain consistency across Reserves. If they are separate, date and time will be combined into a date/time stamp during secondary QAQC, with short name DateTimeStamp and format mm/dd/yyyy hh:mm.

Water quality data review and editing tips

1) **Always archive the data**. Keep copies of the data on other computers, on CD and on other hard drives. Backup and archive on a regular basis to ensure there will be no data loss. Third party software can be purchased to accomplish this. Archive the **raw .DAT** and **raw .CSV data files** from the datasonde as they are retrieved.

2) **Always record in local Standard Time NOT Daylight Savings Time**. Set the clocks on your instruments and the computers that interface with them to Standard Time and DO NOT adjust them to Daylight Savings. Try to get in the habit of recording the time off your watch in Standard Time as well.

3) **Temperature or Conductivity probe failure:** If the temperature sensor malfunctions, then **ALL data** will be inaccurate and need to be rejected. If the conductivity sensor malfunctions or is badly calibrated then **salinity, specific conductivity, DO mg/L (DO concentration) and depth** will need to be rejected.

4) Poor calibrations or sensor malfunctions are evident when plotting multiple deployments, i.e. monthly, seasonal and yearly files. This will be evident when plotting appended files together.

5) **Negative temperature, depth, and turbidity data:** The ONLY negative data that should be included in the data file(s) are from the temperature, depth or turbidity probes.

6) **No data values are to be removed from the dataset under any conditions, except for the removal of pre- and post-deployment records**.

7) **You do not need to delete any non-standard parameters in the dataset prior to conducting secondary QAQC**.

Water quality data management: overview

The management of water quality data consists of the following components:

(1) **Data acquisition** and visual inspection of the raw data in EcoWatch

(2) **Primary QAQC** occurs upon submission of the raw file to the CDMO data upload webpage
   a. Data are posted as provisional on the CDMO ODIS
   b. Data are emailed back to the Reserve with QAQC flags embedded

(3) **Secondary QAQC** of the primary QAQC'd data files and compiled quarterly files with the **NERRQAQC** Excel macro, developed by the CDMO to:
   a. Insert the station code into the dataset
   b. Combine date and time into a date/time stamp if necessary
   c. Insert missing records where the datasonde did not collect data
   d. Format the data according to the specifications in the overview of data collection section
   e. Facilitate the removal of pre- and post-deployment data
   f. Allow the user to view trends in the data with graphing tools and summary statistics
   g. Facilitate the review of data flagged during primary QAQC
   h. Automated documentation of small negative turbidity values that are within accepted sensor error with QAQC flag and code
   i. Allow the user to further document the data by applying QAQC flags and codes
   j. Allow the user to append data files to compile quarterly and yearly files for submission and view trends over multiple deployments
   k. Allow the user to export the data in comma delimited format to the CDMO

(4) **Quarterly data submission** to the CDMO
   a. Data are posted as provisional plus on the CDMO ODIS

(5) **Secondary QAQC** of the compiled yearly file with the NERRQAQC Excel macro

(6) **Metadata documentation** to accompany the dataset

(7) **Annual data submission** to the CDMO for tertiary QAQC
   a. Yearly data file, metadata file, calibration logs, field logs, and raw .DAT file components
   b. The yearly data file is posted as provisional plus on the CDMO ODIS, replacing the submitted quarterly data
   c. Data are posted as authoritative after tertiary QAQC and authentication by the CDMO

(8) **Data archival** onto CD, DVD, a separate computer or hard drive, or to the local network and archival of data into EQWin (optional)

Each component will be discussed in this chapter.

Note: The near real time NERRS SWMP data that are transmitted to the CDMO also go through automated primary data QAQC and are immediately made available as provisional data on the CDMO ODIS. Occasionally some of the data received are missing or erroneous due to satellite transmission errors[7] when correct data were recorded and exist in the instrument itself. **This is why it is strongly recommended that Reserves download the raw files from the YSI at the telemetered stations for submission to the CDMO**. The near real time data are then replaced by provisional plus data, and finally authoritative data, as detailed above.

[7] Transmission errors are due to a disconnection between the YSI and transmitter and transmitter calculation errors.

Water quality data management: data acquisition

Data acquisition with EcoWatch

1) **Downloading the data:** Once the YSI datasonde is retrieved from the field and the post deployment checks are conducted, the data should be downloaded to the local computer in **PC6000 format (.DAT)**.

2) **Inspecting the data:** Use EcoWatch to view and visually check the file, noting any obvious errors or problems.

3) **Adding parameters to output:** Choose **Add/Remove** from the **Setup > Parameters** menu to ensure that the required parameters are listed: DateTime, Temp, SpCond, Sal, DO%, DO Conc, Depth, pH and Turbidity in addition to any diagnostic information or additional parameters you want to include. **I**

IMPORTANT: The new data management process allows Reserves to submit raw files that contain non-standard parameters. Those data will be ignored by the primary QAQC flagging system but remain in the file to allow for more thorough secondary QAQC.

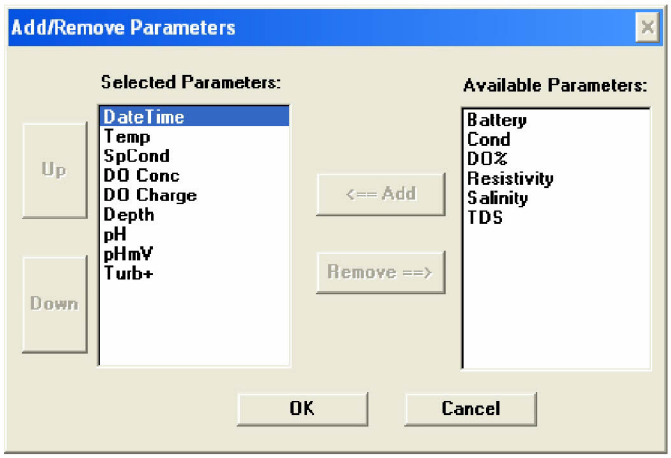


Figure 6. Add/remove parameters in EcoWatch

4) **Maintaining consistency with the parameters output and the parameter order for each station:** While parameter order does not affect processing on the CDMO end, consistency will allow you to append files with the secondary QAQC macro without having to manipulate the order of the columns. Use the **Add/Remove Parameters** tool to shuffle parameters into a consistent order for each deployment. Click the **OK** button when finished.

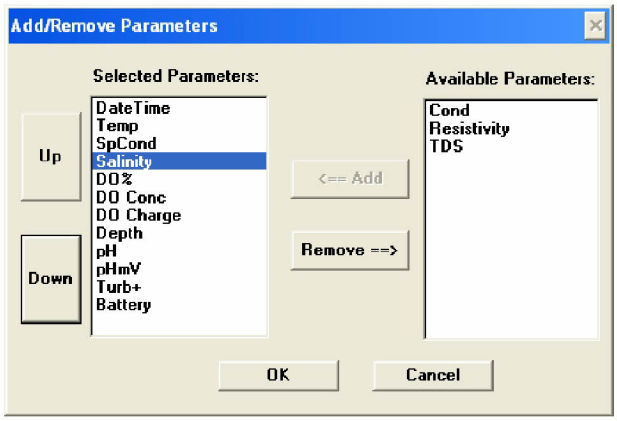


Figure 7. Final changes to add/remove parameters in EcoWatch

5) **Removing extensive[8] unattended pre- and post-deployment data:** After the file has been set up to output the desired parameters, you have the option of removing extensive pre- and post-deployment data from the file before it is exported from EcoWatch. **If you have a file with more than two hours of unattended pre- or post-deployment data, you must remove all but a few hours prior to and after deployment using the Limit Data Set tool in EcoWatch.** If extensive pre- and post-deployment data are uploaded to the CDMO, it will show up on the CDMO ODIS and possibly overwrite in-situ data. **Retaining up to two hours of pre- and post-deployment data is recommended, but not mandatory,** as it may provide important diagnostic information during secondary QAQC. Note that limiting the data in EcoWatch does not remove any of the records from the **.DAT** file itself. Rather, limiting the records affects the exported **.CDF** file. To do this,

   a. Click on the **Toggle table window** button in the EcoWatch toolbar to view the data records.

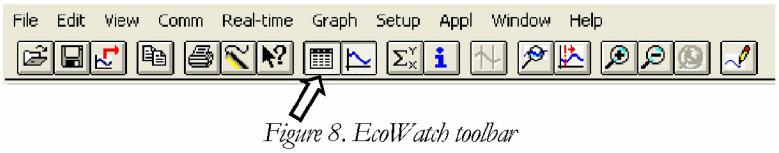


Figure 8. EcoWatch toolbar

   b. In the record number area, select the rows of pre- deployment data you want to limit, then click on the **Limit Data Set** button or choose it from the **Graph menu**. This will cause Ecowatch to ignore those records in the graphing and exporting functions. Do this for any extensive post-deployment data as well. Note that two hours of pre-deployment data remain in the example file to be used for diagnostic purposes during primary and secondary QAQC. Also, if you make a mistake, you can choose **Cancel Limits** from the **Graph menu** and those records will reappear.

[8] Extensive pre- and post-deployment data occurs when the datasonde begins collecting data in the lab two or more hours before it is deployed and continues collecting data in the lab for two or more hours after it is retrieved.

	DateTime	Temp	SpCond	Salinity	DO%	DO Conc	DO Charge	Depth	pH	pHmV	Unknown	Battery
	M/D/Y	C	mS/cm	ppt	%	mg/L		m		mV		V
0	12/18/06 07:45:00	20.85	0.009	0.00	99.1	8.86	60	0.118	7.95	25.3	13.62	1
1	12/18/06 08:00:00	20.70	0.008	0.00	99.1	8.89	60	0.120	7.47	7.6	13.07	1
2	12/18/06 08:15:00	20.65	0.008	0.00	99.0	8.88	60	0.119	7.56	0.1	13.20	1
3	12/18/06 08:30:00	20.63	0.008	0.00	98.8	8.88	60	0.114	7.6	-2.5	13.62	1
4	12/18/06 08:45:00	20.63	0.008	0.00	98.8	8.87	60	0.118	6.86	34.9	13.62	1
5	12/18/06 09:00:00	20.62	0.008	0.00	98.7	8.87	59	0.122	7.55	0.7	13.93	1
6	12/18/06 09:15:00	20.61	0.008	0.00	98.8	8.87	59	0.127	7.70	-7.0	13.01	1
7	12/18/06 09:30:00	20.60	0.008	0.00	98.7	8.87	59	0.125	7.64	-4.0	12.95	1
8	12/18/06 09:45:00	20.56	0.008	0.00	98.7	8.88	59	0.124	7.66	-4.9	13.81	1
9	12/18/06 10:00:00	20.53	0.008	0.00	98.6	8.87	59	0.118	7.80	-11.9	13.07	1
10	12/18/06 10:15:00	20.52	0.008	0.00	98.6	8.88	59	0.126	7.77	-10.5	12.95	1
11	12/18/06 10:30:00	20.51	0.008	0.00	98.6	8.88	59	0.131	7.8	-12.3	13.62	1
12	12/18/06 10:45:00	20.53	0.008	0.00	98.6	8.88	59	0.131	7.84	-13.9	13.13	1
13	12/18/06 11:00:00	20.55	0.008	0.00	98.7	8.87	59	0.131	7.89	-16.6	13.13	1
14	12/18/06 11:15:00	20.55	0.008	0.00	98.6	8.87	59	0.129	7.92	-18.1	13.26	1
15	12/18/06 11:30:00	20.54	0.008	0.00	98.6	8.87	59	0.125	7.96	-19.4	13.32	1
16	12/18/06 11:45:00	20.42	0.008	0.00	98.6	8.89	58	0.123	8.09	-26.4	13.50	1
17	12/18/06 12:00:00	20.24	0.008	0.00	98.7	8.93	59	0.121	8.07	-25.4	13.01	1
18	12/18/06 12:15:00	20.23	0.008	0.00	98.7	8.93	58	0.118	8.09	-26.1	15.84	1
19	12/18/06 12:30:00	20.22	0.008	0.00	98.6	8.92	58	0.114	8.13	-28.3	13.07	1
20	12/18/06 12:45:00	13.85	10.400	5.91	77.5	7.72	55	0.910	6.94	30.8	75.45	1
21	12/18/06 13:00:00	13.76	10.379	5.90	75.7	7.56	55	0.843	7.33	12.0	33.46	1
22	12/18/06 13:15:00	13.70	10.233	5.81	75.2	7.53	55	0.799	7.44	6.4	16.49	1
23	12/18/06 13:30:00	13.77	10.302	5.85	72.6	7.26	55	0.792	7.57	3.2	16.80	1
24	12/18/06 13:45:00	13.69	10.492	5.96	72.6	7.26	54	0.821	7.55	1.2	9.17	1
25	12/18/06 14:00:00	13.75	10.459	5.94	76.1	7.60	55	0.895	7.58	-0.5	10.33	1
26	12/18/06 14:15:00	13.62	10.697	6.09	76.9	7.69	55	1.004	7.61	-1.6	10.51	1
27	12/18/06 14:30:00	13.59	10.749	6.12	76.3	7.64	55	1.106	7.62	-2.2	10.27	1
28	12/18/06 14:45:00	13.61	10.955	6.25	76.5	7.65	55	1.208	7.64	-3.1	11.30	1
29	12/18/06 15:00:00	13.56	11.026	6.29	76.2	7.62	55	1.319	7.64	-3.3	10.82	1
30	12/18/06 15:15:00	13.43	11.206	6.40	75.3	7.56	55	1.456	7.64	-3.0	11.36	1
31	12/18/06 15:30:00	13.23	11.919	6.84	75.7	7.60	55	1.588	7.63	-2.8	12.28	1
32	12/18/06 15:45:00	13.32	11.979	6.88	75.9	7.61	55	1.704	7.67	-4.4	9.96	1
33	12/18/06 16:00:00	13.33	12.135	6.97	76.1	7.62	55	1.803	7.66	-4.2	10.21	1
34	12/18/06 16:15:00	13.53	11.917	6.84	76.9	7.68	55	1.891	7.69	-5.7	10.88	1
35	12/18/06 16:30:00	13.60	10.706	6.10	79.0	7.91	55	1.982	7.69	-5.9	10.39	1

Figure 9. Removing extensive pre- and post-deployment data

c. Once the data set has been limited to your satisfaction, the data are ready to be exported.

6) The **PC6000 format (.DAT) file** is then ready to be exported as a **comma separated file** by choosing **Export > CDF/WMF** from the **File** menu.

a. Ensure the **Comma Delimited (.CDF)** radio button is selected in the **Export Format** box. It is no longer necessary to rename the default file extension **.CDF** to **.CSV** since both extensions export the data as a comma separated/delimited file. Also, the **Separate Time/Date** box no longer needs to be checked.

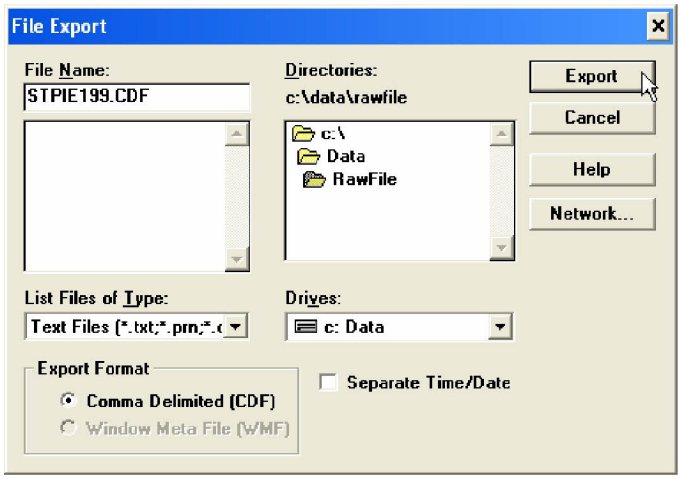


Figure 10. Exporting the file

7) Rename the exported file to follow the required CDMO naming convention using the 3 letter Reserve code, 2 letter sampling site code, date type code (wq), and file start date in MMDDYY format.

8) Now the file is ready to be uploaded to the CDMO for primary QAQC. R**aw data files must be submitted to CDMO for automated primary QAQC and provisionary posting within one week of data retrieval from the instrument.**

Water quality data management: primary QAQC

Primary QAQC flags

There are eleven QAQC flags ranging from -5 to 5. Initial QAQC flags are applied during the automated primary QAQC after a Reserve uploads raw data to the CDMO. During primary QAQC, data are flagged if they are out of sensor range or missing. All remaining data are flagged as having passed initial QAQC checks. **Note that all data with flags of less than 0 will be masked from the data visualization tools on the CDMO ODIS[9].**

-5 Outside high sensor range: Used during primary QAQC when a value is above the upper limit of the sensor range. Upper limits used for primary QAQC are:

Temp	45 deg
SpCond	100 ms/cm
Sal	70 ppt
DO_pct	500 %
DO_mgl	50 mg/L
Depth	61 m
Level	61 m
pH	14
Turb	1000 NTU
ChlFluor	400 ug/L

Table 2. Upper limits for WQ data

-4 Outside low sensor range: Used during primary QAQC when a value is below the lower limit of the sensor range. Lower limits used for primary QAQC are:

Temp	-5 deg
SpCond	0 ms/cm
Sal	0 ppt
DO_pct	0 %
DO_mgl	0 mg/L
Depth	0 m
Level	-20 m[10]
pH	2
Turb	0 NTU
ChlFluor	0 ug/L

Table 3. Lower limits for WQ data

[9] All data regardless of the QAQC flag value are available for export via the CDMO ODIS.
[10] Low sensor range for Level is an arbitrarily chosen negative value and is not a sensor specification.

-2 **Missing data:** Used during primary and secondary QAQC where a value is missing (not collected).

0 **Data passed initial QAQC checks:** Used during primary QAQC on all remaining data.

4 **Historical: Pre-automated QAQC:** Used to indicate data that were submitted to the CDMO prior to the use of the automated primary QAQC system. You will only see this flag in data that are exported from the CDMO ODIS and not in the primary QAQC data file.

Raw data submission for primary QAQC

Considerations before submitting to the CDMO:

When a file with extensive pre- and post-deployment data is uploaded to the CDMO, it will show up on the CDMO ODIS and possibly overwrite in-situ data from the last deployment. Therefore, ensure that the file exported from EcoWatch does not contain more than a few hours of pre- and post-deployment data by using the limit dataset tool.

Ensure that the file exported from EcoWatch contains a header and a units row, otherwise the upload process will be aborted.

Ensure that the file is in **comma delimited format** (where commas separate the values). The file extensions available for export from EcoWatch as a comma delimited file include **.CDF**, **.CSV** or **.TXT**.

The **required naming convention for raw data uploaded to the CDMO** is the three letter Reserve code, two letter sampling site code, data type code, and file start date MMDDYY (ex: acemcwq011509). This will enable the CDMO to verify that data are uploaded to the appropriate Reserve, station, and data type tables, thereby reducing upload errors. There is no required naming convention for the raw **.DAT** files submitted to the CDMO via ftp.

Follow the instructions below for the submission of the raw WQ data to the CDMO:

1) **Log into the CDMO data submission webpage using your Reserve username and password at http://cdmo.baruch.sc.edu/DataUpload/index.cfm.** Contact the CDMO support team at cdmosupport@belle.baruch.sc.edu to obtain your username and password if you do not have it. The CDMO ODIS can set a cookie to remember your username and password if you check the **Remember Me?** box. Click **Log into CDMO** to continue.

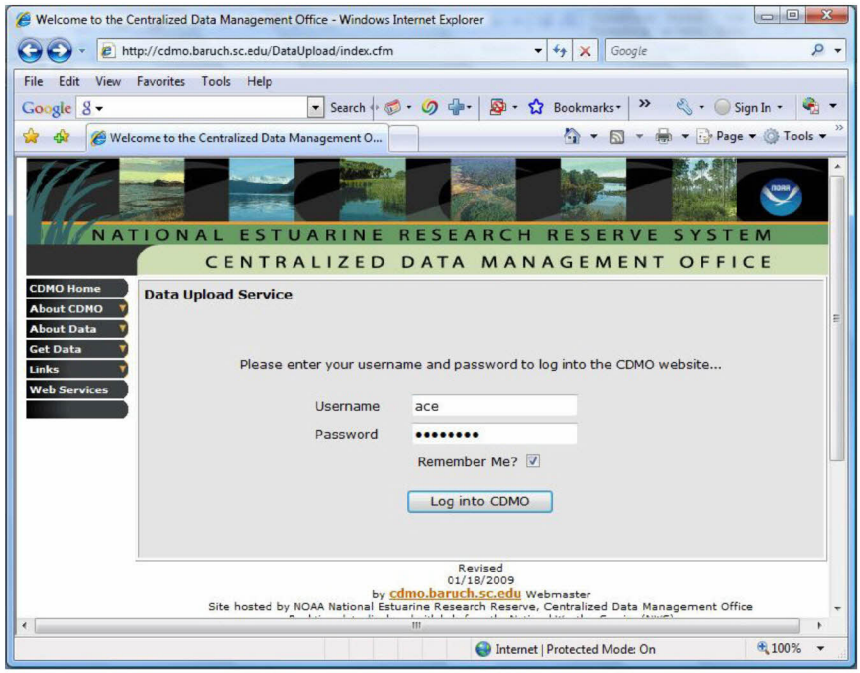


Figure 11. Log into CDMO

2) **Designate the type of data you wish to upload by choosing the WQ and RAW radio buttons.** Enter a valid email address so that the primary QAQC'd data file can be emailed to you. You will use this file to conduct secondary QAQC using the tools provided by the CDMO. Click on the **Continue** button to proceed.

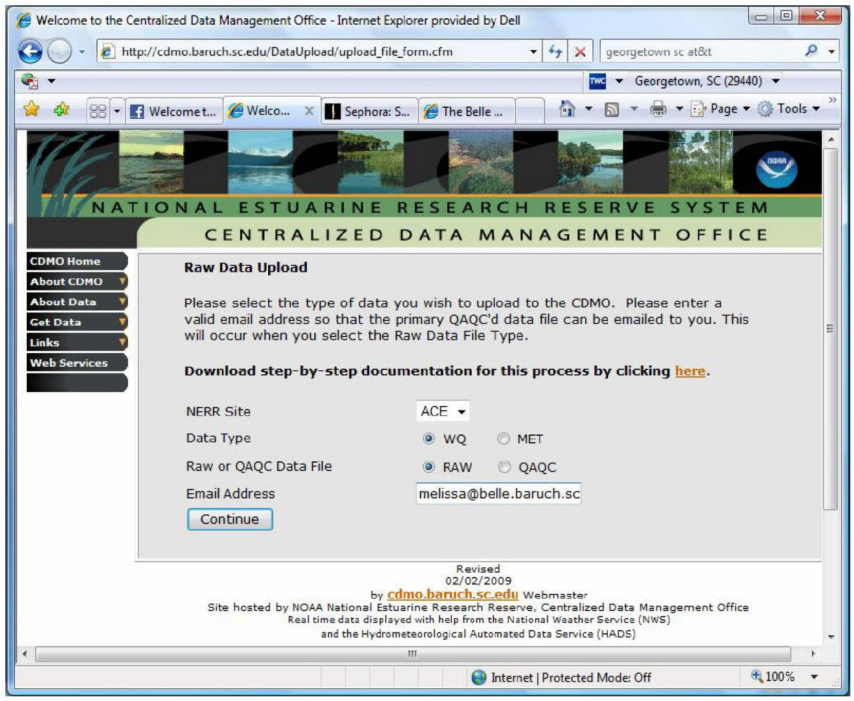


Figure 12. Specify type of data to upload

3) **Specify the file to upload to the CDMO.** The NERR Site is provided based on the initial login. The Sampling Stations drop down list will be populated based on the data type chosen on the previous page.

   a. Choose the sampling station and year of data that you are uploading. A copy of the raw file you upload will be placed in the appropriate yearly raw data folder on the CDMO FTP server. For example, if you are uploading a 2008 ACE water file, a copy of the file will automatically be placed into the Ace Basin/water quality/data/raw/2008 file folder on the CDMO FTP server. If your file contains data spanning two years, you should upload the file under both years to ensure that it is archived properly. **This step partially satisfies your raw data submission requirement automatically.**

   b. Use the **Browse** button to locate the file to upload on your computer.

   c. Click on the **Upload** button to proceed.

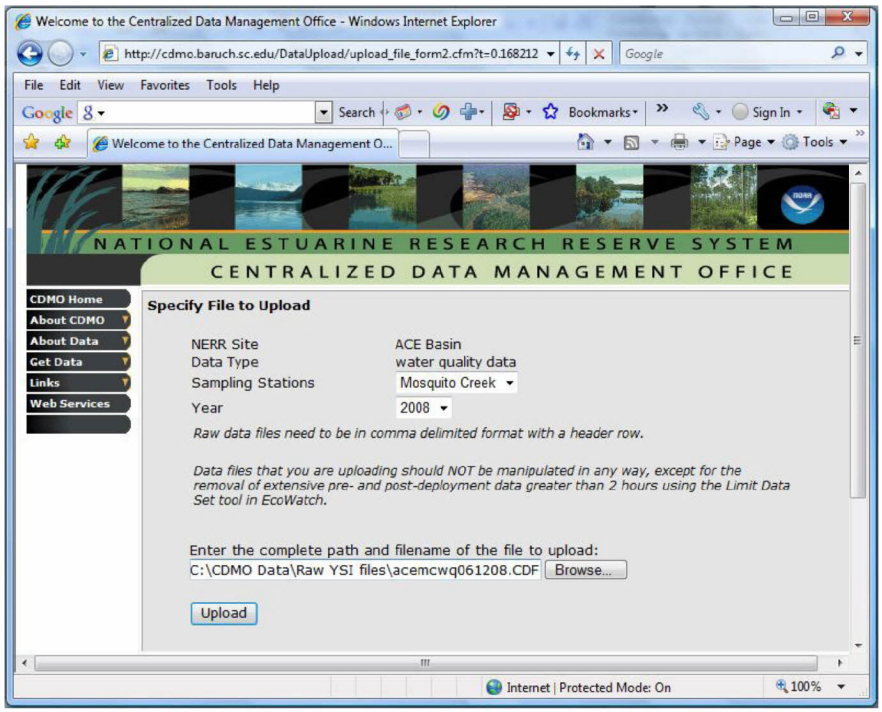


Figure 13. Specify file to upload

4) The file will now be checked against the CDMO database of required SWMP parameters and header information will be extracted.

   a. **Troubleshooting:** If the file is not in comma delimited format or does not have the right header information, such as a units row, you will receive a **"Process aborted"** alert. If you need assistance, contact the CDMO support team at cdmosupport@belle.baruch.sc.edu.

5) **You will now be asked to verify the parameters in the data file.** If there are any parameter headers that do not match the CDMO database of required SWMP parameters, you will have an opportunity to identify those parameters now. (Sometimes different datasonde software outputs different headers for the same parameter). Only the designated SWMP parameters will be ingested into the CDMO database, go through primary QAQC and subsequently be made available as provisional data on the CDMO ODIS. All **Non Standard Parameter** data will be returned to you in the primary QAQC'd data file to assist with a more thorough secondary QAQC.

   a. **Required WQ SWMP parameters include:**

      Water temperature, specific conductivity, salinity, DO percent saturation, DO concentration, depth or level, pH and turbidity

      Optional WQ SWMP supported parameters include:

      Chlorophyll fluorescence

   b. Use the drop down list to match up any unidentified parameters in the file with the correct table reference. If it is a non-required SWMP parameter, such as diagnostic information, make sure **Non Standard Parameter** is chosen.

   c. If the file contains dissolved oxygen data from both the rapid-pulse and ROX DO sensors, you must choose **Non Standard Parameter** for one set of DO parameters.

   d. If the file contains an optional SWMP supported parameter, such as chlorophyll fluorescence, you may choose to designate it as a **Non Standard Parameter** so that it will not be added to the CDMO ODIS, or you may choose the ChlFluor table reference from the drop down list for inclusion in the database and primary QAQC.

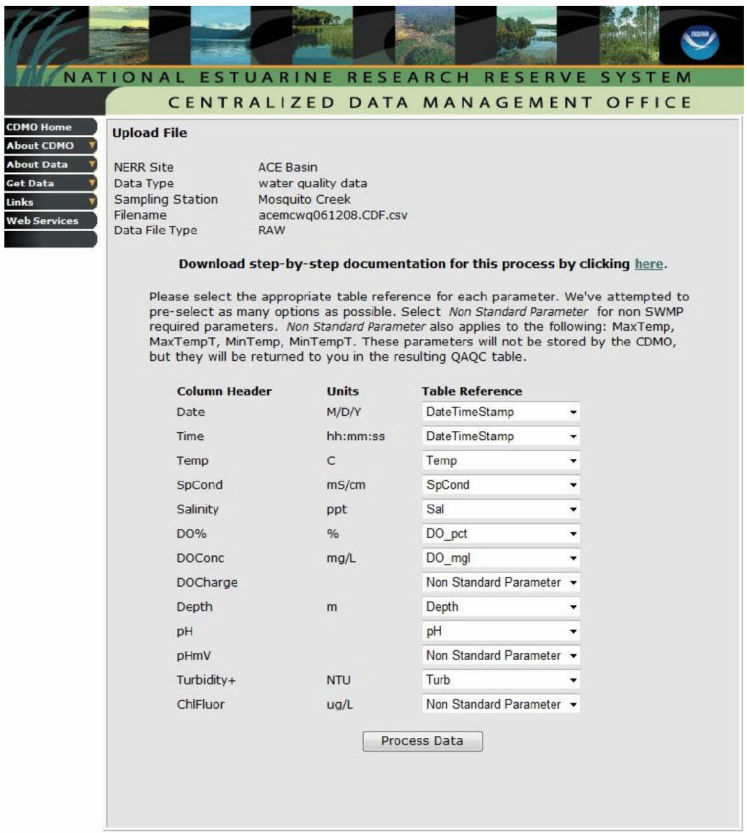


Figure 14. Verify parameter names

e. Once all the parameters have been correctly identified, click the **Process Data** button for the data to be imported into the CDMO database.

6) **The following actions occur as the data are ingested into the CDMO database**:

a. The date and times are corrected to read exactly on the quarter hour. This eliminates the appearance of duplicate data on the ODIS and in the database.

b. As the data go through primary QAQC, flag columns are inserted after every required or optional SWMP parameter and given a header preceded by a F_. Each value is checked and a QAQC flag inserted into the parameter flag column.

7) Once the raw data have been successfully uploaded to the CDMO, you will be notified of the number of records that were inserted into the CDMO database. Click the **Upload more files** button to upload additional files to the CDMO.

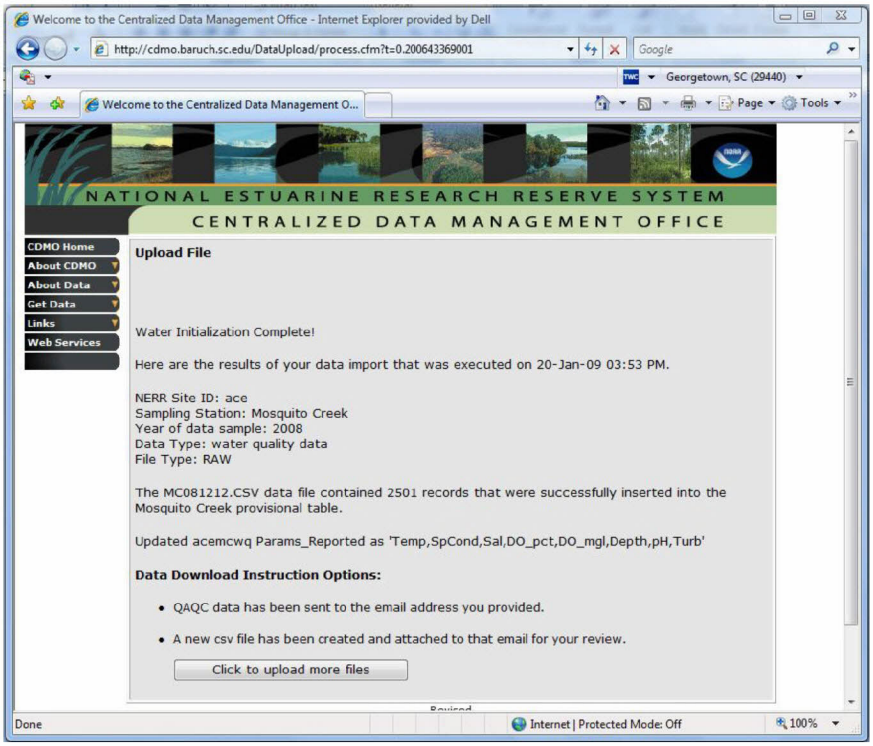


Figure 15. Upload complete

8) **The primary QAQC'd file will now be emailed[11] to you**. You will use this file to conduct secondary QAQC using the **NERRQAQC** Excel macro provided by the CDMO. Note that the primary QAQC'd file has been renamed with a "_QC" appended to the end of the filename.

   a. Open the email and save the attached data file to a folder that specifically contains primary QAQC data from the CDMO.

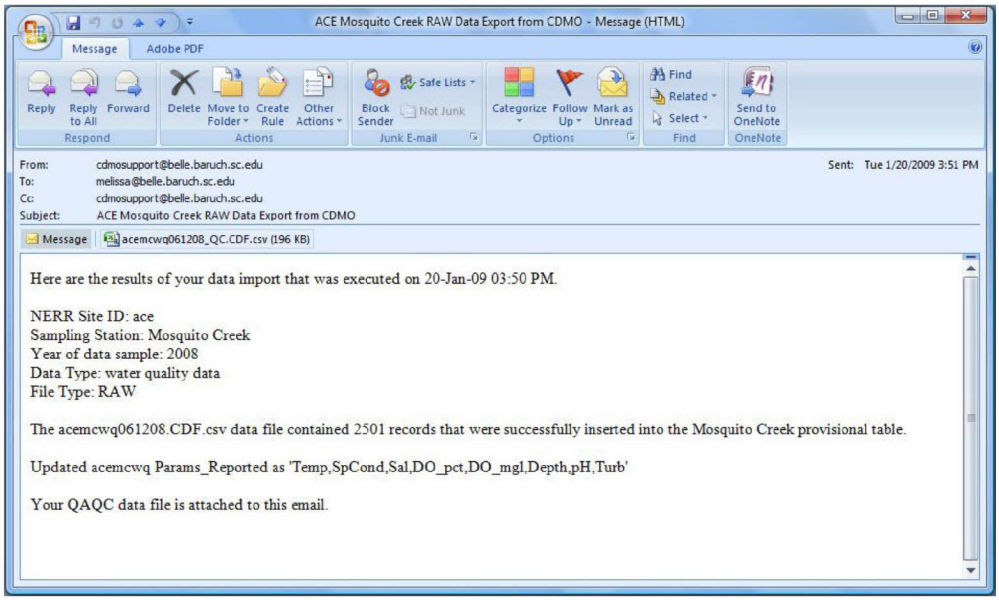


Figure 16. Email with processed data attached

9) The primary QAQC'd file is now ready for secondary QAQC.

[11] Email delivery time should occur within a few minutes of a successful data submission.

Water quality data management: secondary QAQC

During primary QAQC, QAQC flags are automatically entered into the dataset flag columns to indicate if data are out of sensor range or missing.

During secondary QAQC at the Reserve, QAQC flags and codes are entered directly into the dataset with the use of the NERRQAQC macro to provide additional data documentation. These QAQC flags and codes thus become metadata for the data, making this documentation more accessible to the user and reducing the amount of written documentation that must accompany the dataset.

Secondary QAQC flags

- **-3 Rejected data:** Used during secondary QAQC to indicate a rejected value. **No data values are to be removed from the dataset under any conditions** except for the removal of any pre- and post-deployment records if desired.
- **-2 Missing data:** Inserted by the CDMO during primary and secondary QAQC where a value is missing (not collected).
- **-1 Optional SWMP supported parameter:** Inserted by the CDMO to indicate an optional parameter that was not collected.
- **1 Suspect data:** Used during secondary QAQC to indicate a suspect value.
- **5 Corrected data:** Used during secondary QAQC to indicate a value that has been corrected or changed[12].

When to use QAQC flags

Secondary QAQC flags should be applied to any data considered to be **rejected, suspect, or corrected.**

Primary QAQC flags of -4 or -5, indicating values that are out of instrument range**, must be replaced with either -3 or 1 flags.**

You cannot apply a 0 flag over any primary QAQC flag.

Only one QAQC flag is allowed per value.

If a General or Sensor Error code is applied, a secondary QAQC flag should be applied as well.

[12] The worksheet will have to be unprotected in order to correct the data.

Secondary QAQC codes

QAQC codes are used during secondary QAQC to allow for further documentation of the data. QAQC codes fall into three categories:

1) **General errors:** Used to document general problems with the deployment or common instrument related errors. Cannot be used in combination with a sensor error code.

GIC	No instrument deployed due to ice
GIM	Instrument malfunction[13]
GIT	Instrument recording error; recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GNF	Deployment tube clogged/no flow
GOW	Out of water event;
GPF	Power failure/low battery
GQR	Data rejected due to QAQC checks
GSM	See metadata

2) **Sensor errors:** Used to document common sensor specific problems. Cannot be used in combination with a general error code.

SBO	Blocked optic
SCF	Conductivity sensor failure
SDO	DO suspect
SDP	DO membrane puncture
SIC	Incorrect calibration/contaminated standard
SNV	Negative value
SOW	Sensor out of water
SPC	Post calibration out of range
SSD	Sensor drift
SSM	Sensor malfunction
SSR	Sensor removed/not deployed
STF	Catastrophic temperature sensor failure
STS	Turbidity spike
SWM	Wiper malfunction/loss

3) **Comments:** Can be used alone or in combination with a general error or sensor error code to further document conditions or a problem with the data.

CAB	Algal bloom
CAF	Acceptable calibration/accuracy error of sensor
CAP	Depth sensor in water; affected by atmospheric pressure
CBF	Biofouling
CCU	Cause unknown
CDA	DO hypoxia (<3 mg/L)
CDB	Disturbed bottom
CDF	Data appear to fit conditions
CFK	Fish kill
CIP	Surface ice present at sample station
CLT	Low tide
CMC	In field maintenance/cleaning

[13] YSI datasonde related malfunctions.

CMD	Mud in probe guard
CND	New deployment begins
CRE	Significant rain event
CSM	See metadata
CTS	Turbidity spike
CVT	Possible vandalism/tampering
CWD	Data collected at wrong depth

The QAQC codes available for use during secondary QAQC are accessible from the **Apply Flag Codes** tool within the NERRQAQC macro. These codes cover the most common problems encountered with the NERR SWMP data. The "CSM" see metadata comment code can be applied to the data to cover additional problems that do not have their own QAQC codes, or that require a more detailed explanation, and are further documented in the Microsoft Word metadata document that will accompany the dataset. To request additional codes, contact the CDMO data management team at cdmo@belle.baruch.sc.edu. If the majority of the NERR community is in agreement, we will include them in the next release of the NERRQAQC macro.

When to use QAQC codes

A QAQC code must be applied to any data flagged as -3, 1, or 5 for documentation purposes. Remember, there will be no -4 or -5 QAQC flags in the secondary QAQC'd data as these flags must be replaced with either -3 or 1.

A maximum of two QAQC codes are allowed per value. A general error code cannot be used in combination with a sensor error code and vice versa. You must choose the most appropriate general or sensor error to use when documenting a value. However, a comment code can be used in addition to a general error or sensor error code.

Considerations before conducting secondary QAQC

Be sure to have the most up to date version of the NERRQAQC macro.

No data values are to be removed from the dataset under any conditions, except for the removal of pre- and post-deployment records. Rather, the use of QAQC flags will indicate whether a value has been flagged as suspect, rejected or if the value has been corrected.

Maintaining parameter consistency: It is advised that data submitted from each monitoring location be consistent regarding the parameters measured and the parameter order. This will ensure that you can easily append files during secondary QAQC.

You do not need to delete any non-standard parameters in the dataset prior to or after conducting secondary QAQC. Non-standard parameters will not have an associated flag column after primary QAQC and the CDMO simply will not ingest them when the secondary QAQC'd file is submitted back to the CDMO.

You will need to periodically save the Excel data workbook because it is the working QAQC file. Saving the file as an Excel workbook will allow you to continue QAQC on the file at any time and preserve a record of all the metadata sheets and the deployment records sheet.

Overview of the NERRQAQC macro

The NERRQAQC macro will perform the following tasks:

1) **Step 1: Open Data File**
    a. Allow the user to open the primary QAQC data file emailed from the CDMO.
2) **Step 2: Enter Station Code**
    a. Allow the user to insert the station code into the dataset.
    b. Combine the Date and Time columns into one DateTimeStamp column if necessary.
    c. Format the data according to the specifications in the overview of data collection section.
    d. Insert missing records into the dataset where the datasonde did not collect.
    e. Highlight any data that were flagged during primary QAQC with a yellow background.
    f. Automatically flag turbidity values from 0 to -2 as suspect (rather than out of sensor range) and code appropriately.
    g. Insert metadata sheets for all QAQC flags and copy any data flagged during primary QAQC into the appropriate sheet.
    h. Insert a deployment records sheet for archival of removed pre- and post-deployment data.
    i. Protect the data columns.
3) **Step 3: Create Charts**
    a. Allow the user to automatically generate a single or dual parameter chart.
4) **Step 4: Apply Flag Codes**
    a. Remove pre- and post-deployment data from the file and move to deployment records sheet.
    b. Insert QAQC flags and codes into the flag columns of the dataset.
    c. Undo any flagging if necessary.
5) **Step 5: Synchronize Metadata Sheets**
    a. Synchronize flagged data between the data and metadata sheets and update summary statistics to facilitate QAQC and metadata documentation.
6) **Step 6: Save as Excel File**
    a. Save your workbook as an Excel file.
7) **Step 7: Append Excel File**
    a. Append QAQC'd Excel files together.
8) **Step 8: Export CSV File**
    a. Export the final QAQC'd file in **.CSV** (comma delimited) format.
9) **Run Statistics**
    a. Calculate min, max, average, and standard deviation for each parameter

Step 1: Open Data File

Use the **Open Data File** tool to open the primary QAQC data file emailed to you from the CDMO. Refer to the email from the cdmosupport@belle.baruch.sc.edu address titled "*your Reserve code and sampling station* RAW Data Export from CDMO".

1) Click on the **NERR QAQC Main Menu** button in the Excel toolbar.

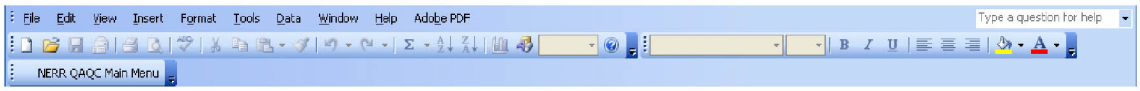


Figure 17. NERR QAQC toolbar

2) The **NERR QAQC Main Menu** window will open allowing you to launch each step of the macro for data processing. Note that you will have to open and close this menu as you work through each step.

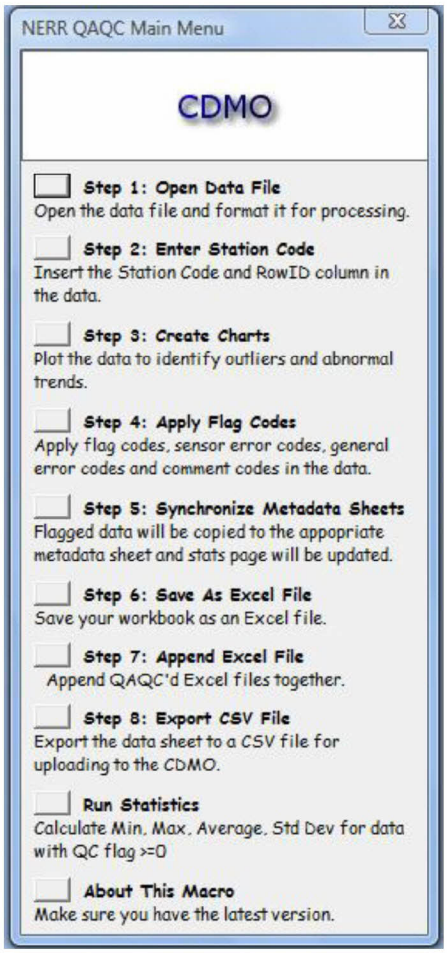


Figure 18. NERR QAQC main menu

3) Click on the **Step 1: Open Data File** button.

4) After activating the **Open Data File** tool, an **Open** file window will appear. Browse to the folder containing the primary QAQC'd data files, choose the file then select **Open.**

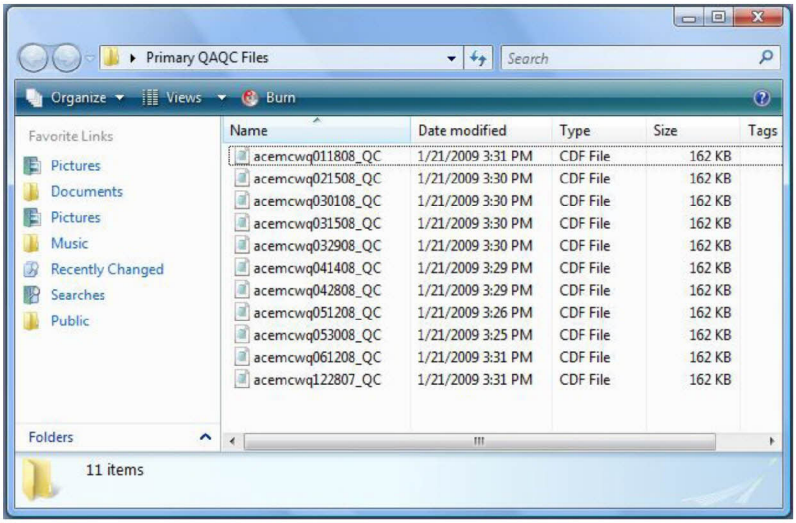


Figure 19. Open file window

5) The following window will appear once the file has successfully been opened.

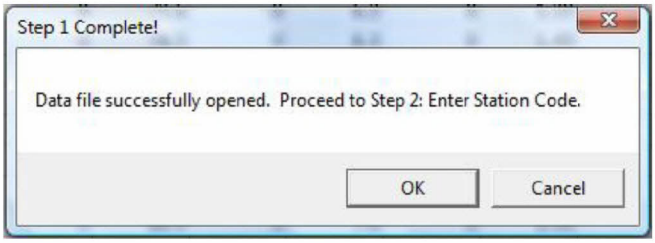


Figure 20. Step 1 complete window

6) Click **OK** to proceed to **Step 2: Enter Station Code**.

Step 2: Enter Station Code

The **Enter Station Code** tool will insert the station code into the dataset, format the data, and prepare the data file and Excel workbook for secondary QAQC by the Reserve.

1) Once the file has been opened with the **Open Data File** tool, the **Enter Station Code** tool will automatically launch and you will be prompted to insert the station code.
    a. The station code conforms to the following naming convention: **the three letter NERR site ID, the two letter sampling station ID and the two letter data type (wq)**.

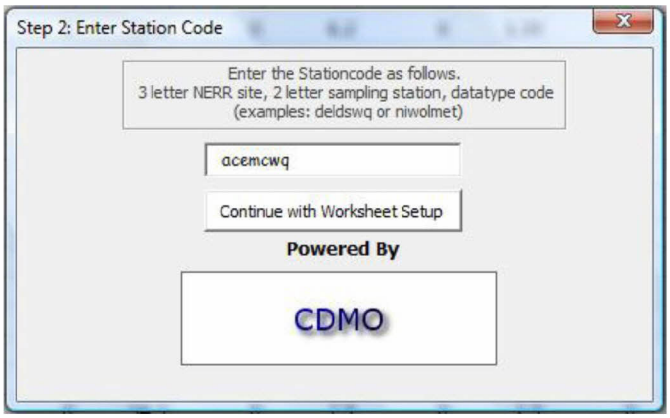


Figure 21. Enter station code prompt

2) Once the station code has been entered, select **Continue with worksheet setup** and the following will occur:
    a. A RowID column will be inserted as the first column of each row. This column is used to synchronize the flags and codes from the metadata sheet to the data sheet.
    b. The station code will be entered as the second column of each row.
    c. Missing records will be inserted where the datasonde did not collect.
    d. The data will be formatted according to the format listed under the **Overview of data collection** section.
    e. Any flag values not equal to 0 in the flag columns will be enclosed with <> and highlighted in yellow to make discovery easier on the user.
    f. Small negative turbidity values between 0 and -2 that were flagged as out of sensor range during primary QAQC will automatically be coded as CAE for "acceptable calibration / accuracy error of sensor" and the flag will be changed to 1 to indicate that the data are suspect.
    g. Metadata worksheets will be created and all flagged data will be copied into them.
    h. A "Deployment Records" worksheet will be created to contain pre- and post-deployment data deleted during secondary QAQC.
    i. Every column except the flag columns will be protected. This will ensure the parameter values are not mistakenly changed or removed when applying QAQC flags or QAQC codes.

3) The following window will appear when the **Enter Station Code** tool has finished processing the data. Select **OK** and the **Create Charts** tool will automatically launch.

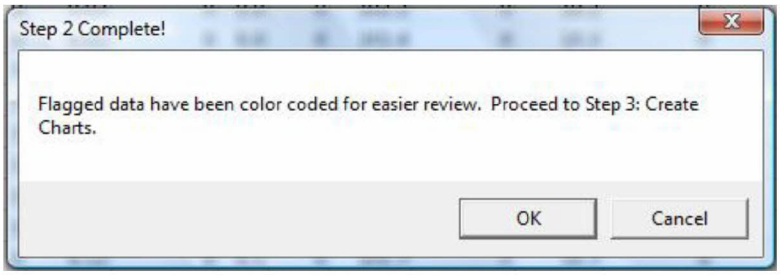
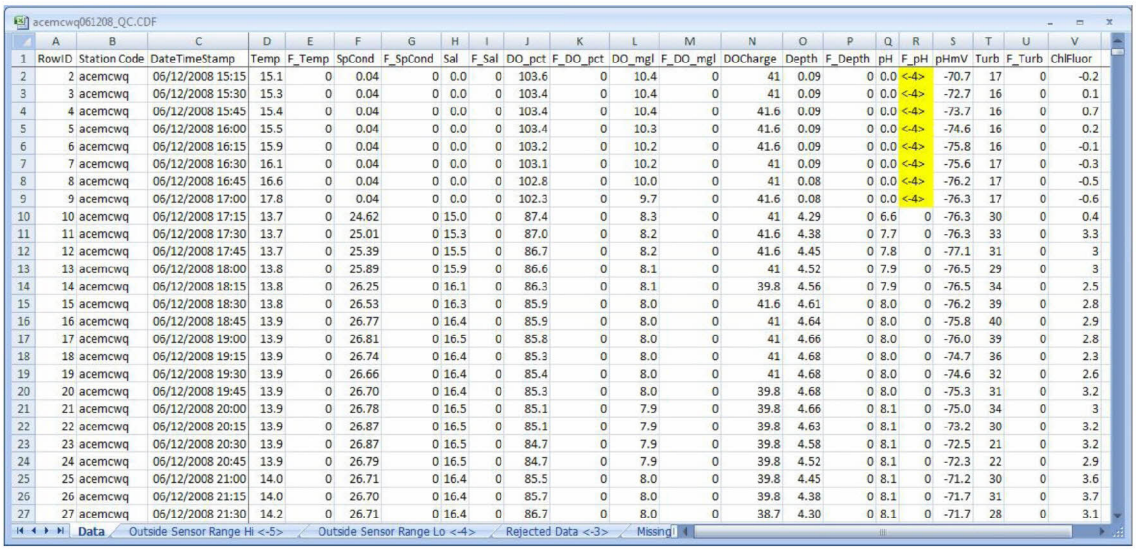


Figure 22. Step 2 complete window

4) The data will look like the following figure after processing.



acemcwq061208_QC.CDF

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	RowID	Station Code	DateTimeStamp	Temp	F_Temp	SpCond	F_SpCond	Sal	F_Sal	DO_pct	F_DO_pct	DO_mgl	F_DO_mgl	DOCharge	Depth	F_Depth	pH	F_pH	pHmV	Turb	F_Turb	ChlFluor
2	2	acemcwq	06/12/2008 15:15	15.1	0	0.04	0	0.0	0	103.6	0	10.4	0	41	0.09	0	0.0	<-4>	-70.7	17	0	-0.2
3	3	acemcwq	06/12/2008 15:30	15.3	0	0.04	0	0.0	0	103.4	0	10.4	0	41	0.09	0	0.0	<-4>	-72.7	16	0	0.1
4	4	acemcwq	06/12/2008 15:45	15.4	0	0.04	0	0.0	0	103.4	0	10.4	0	41.6	0.09	0	0.0	<-4>	-73.7	16	0	0.7
5	5	acemcwq	06/12/2008 16:00	15.5	0	0.04	0	0.0	0	103.4	0	10.3	0	41.6	0.09	0	0.0	<-4>	-74.6	16	0	0.2
6	6	acemcwq	06/12/2008 16:15	15.9	0	0.04	0	0.0	0	103.2	0	10.2	0	41.6	0.09	0	0.0	<-4>	-75.8	16	0	-0.1
7	7	acemcwq	06/12/2008 16:30	16.1	0	0.04	0	0.0	0	103.1	0	10.2	0	41	0.09	0	0.0	<-4>	-75.6	17	0	-0.3
8	8	acemcwq	06/12/2008 16:45	16.6	0	0.04	0	0.0	0	102.8	0	10.0	0	41	0.08	0	0.0	<-4>	-76.2	17	0	-0.5
9	9	acemcwq	06/12/2008 17:00	17.8	0	0.04	0	0.0	0	102.3	0	9.7	0	41.6	0.08	0	0.0	<-4>	-76.3	17	0	-0.6
10	10	acemcwq	06/12/2008 17:15	13.7	0	24.62	0	15.0	0	87.4	0	8.3	0	41	4.29	0	6.6	0	-76.3	30	0	0.4
11	11	acemcwq	06/12/2008 17:30	13.7	0	25.01	0	15.3	0	87.0	0	8.2	0	41.6	4.38	0	7.7	0	-76.3	33	0	3.3
12	12	acemcwq	06/12/2008 17:45	13.7	0	25.39	0	15.5	0	86.7	0	8.2	0	41.6	4.45	0	7.8	0	-77.1	31	0	3
13	13	acemcwq	06/12/2008 18:00	13.8	0	25.89	0	15.9	0	86.6	0	8.1	0	41	4.52	0	7.9	0	-76.5	29	0	3
14	14	acemcwq	06/12/2008 18:15	13.8	0	26.25	0	16.1	0	86.3	0	8.1	0	39.8	4.56	0	7.9	0	-76.5	34	0	2.5
15	15	acemcwq	06/12/2008 18:30	13.8	0	26.53	0	16.3	0	85.9	0	8.0	0	41.6	4.61	0	8.0	0	-76.2	39	0	2.8
16	16	acemcwq	06/12/2008 18:45	13.9	0	26.77	0	16.4	0	85.9	0	8.0	0	41	4.64	0	8.0	0	-75.8	40	0	2.9
17	17	acemcwq	06/12/2008 19:00	13.9	0	26.81	0	16.5	0	85.8	0	8.0	0	41	4.66	0	8.0	0	-76.0	39	0	2.8
18	18	acemcwq	06/12/2008 19:15	13.9	0	26.74	0	16.4	0	85.3	0	8.0	0	41	4.68	0	8.0	0	-74.7	36	0	2.3
19	19	acemcwq	06/12/2008 19:30	13.9	0	26.66	0	16.4	0	85.4	0	8.0	0	41	4.68	0	8.0	0	-74.6	32	0	2.6
20	20	acemcwq	06/12/2008 19:45	13.9	0	26.70	0	16.4	0	85.3	0	8.0	0	39.8	4.68	0	8.0	0	-75.3	31	0	3.2
21	21	acemcwq	06/12/2008 20:00	13.9	0	26.78	0	16.5	0	85.1	0	7.9	0	39.8	4.66	0	8.1	0	-75.0	34	0	3
22	22	acemcwq	06/12/2008 20:15	13.9	0	26.87	0	16.5	0	85.1	0	7.9	0	39.8	4.63	0	8.1	0	-73.2	30	0	3.2
23	23	acemcwq	06/12/2008 20:30	13.9	0	26.87	0	16.5	0	84.7	0	7.9	0	39.8	4.58	0	8.1	0	-72.5	21	0	3.2
24	24	acemcwq	06/12/2008 20:45	13.9	0	26.79	0	16.5	0	84.7	0	7.9	0	39.8	4.52	0	8.1	0	-72.3	22	0	2.9
25	25	acemcwq	06/12/2008 21:00	14.0	0	26.71	0	16.4	0	85.5	0	8.0	0	39.8	4.45	0	8.1	0	-71.2	30	0	3.6
26	26	acemcwq	06/12/2008 21:15	14.0	0	26.70	0	16.4	0	85.7	0	8.0	0	39.8	4.38	0	8.1	0	-71.7	31	0	3.7
27	27	acemcwq	06/12/2008 21:30	14.2	0	26.71	0	16.4	0	86.7	0	8.0	0	38.7	4.30	0	8.1	0	-71.7	28	0	3.1

Data | Outside Sensor Range Hi <-5> | Outside Sensor Range Lo <-4> | Rejected Data <-3> | Missing

Figure 23. WQ data after processing

a. Note the pH millivolts column. If this diagnostic parameter is named pH in your deployment files, renaming it with the mV designation will allow you to create a chart for pH millivolts in Step 3 of the macro. You will need to unprotect the worksheet to rename the parameter, be sure to protect it again when you are done.

5) **Save the Excel workbook!** To do this, you must close the **Create Charts** window and choose **Step 6: Save as Excel File** from the **NERR QAQC Main Menu** window. Name the data workbook (suggestion: acemcwq061208_QC2) and save it in a dedicated directory for Secondary QAQC files. Do this periodically while working with each file. **This Excel workbook is your working QAQC file,** saving it as an Excel workbook will allow you to continue QAQC on the file at any time..

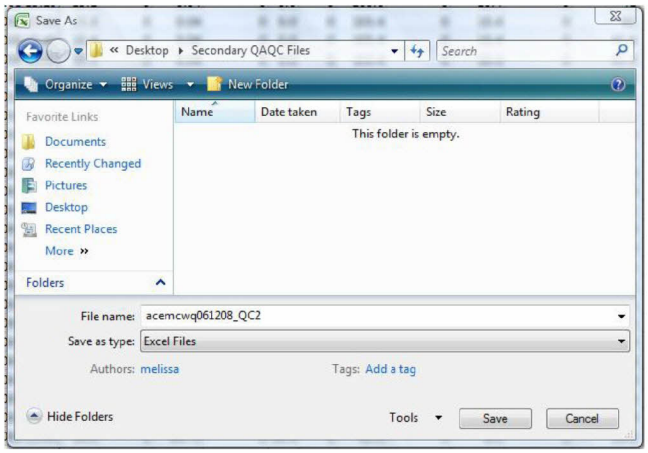


Figure 24. Save as window

Step 3: Create Charts

The **Create Charts** tool will allow you to easily create plots of any parameter in the data sheet.

1) After saving your work, reopen the **NERR QAQC Main Menu** and select **Step 3: Create Charts** to continue.

2) Option 1: Choose the **Create Charts for all Parameters** button to automatically generate charts for each parameter in your data file.

3) Option 2: Select two parameters to plot together from the drop down lists. Click the **Create Chart for Specified Parameters** button to plot the data.

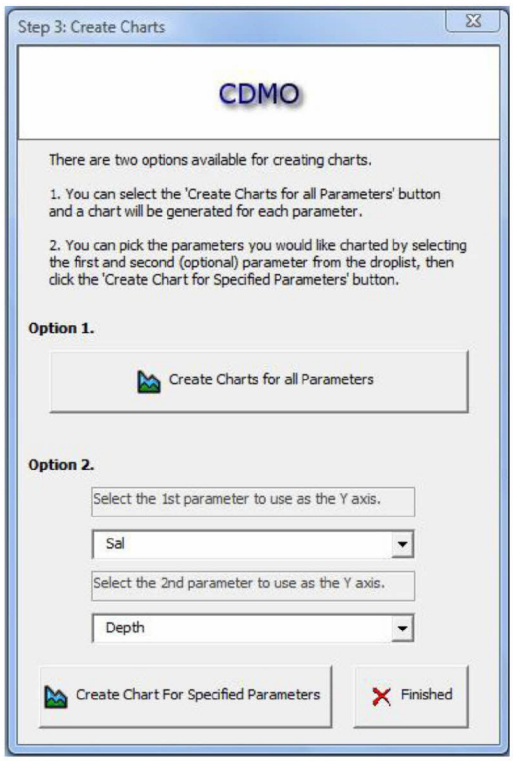


Figure 25. Create charts window

4) Each chart will appear in a new worksheet labeled with "chart" and the appropriate parameter(s).

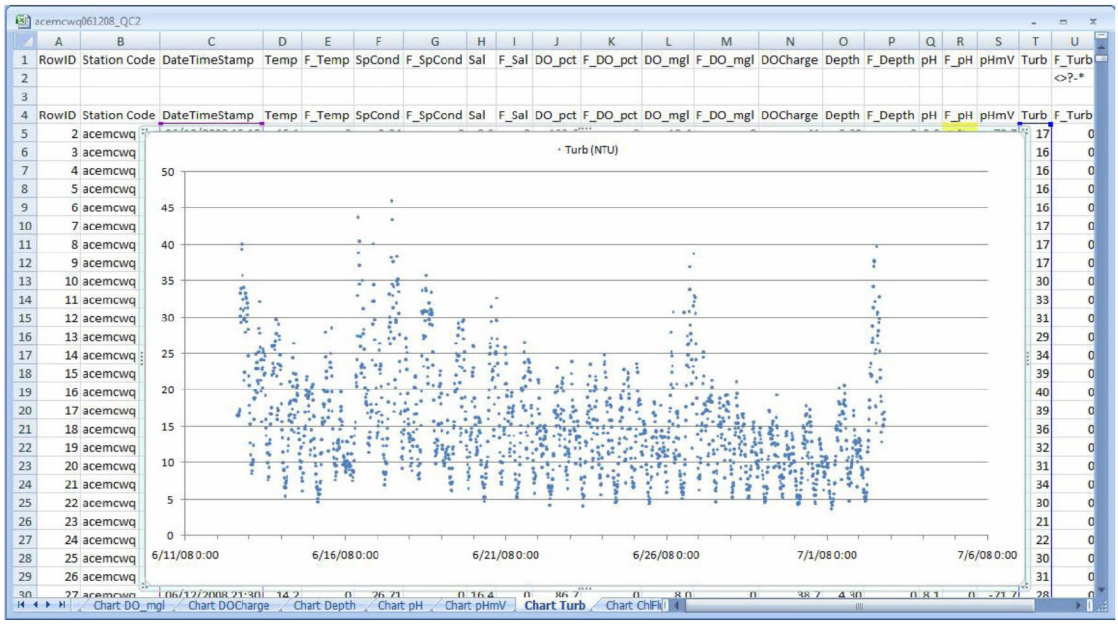


Figure 26. Turbidity chart

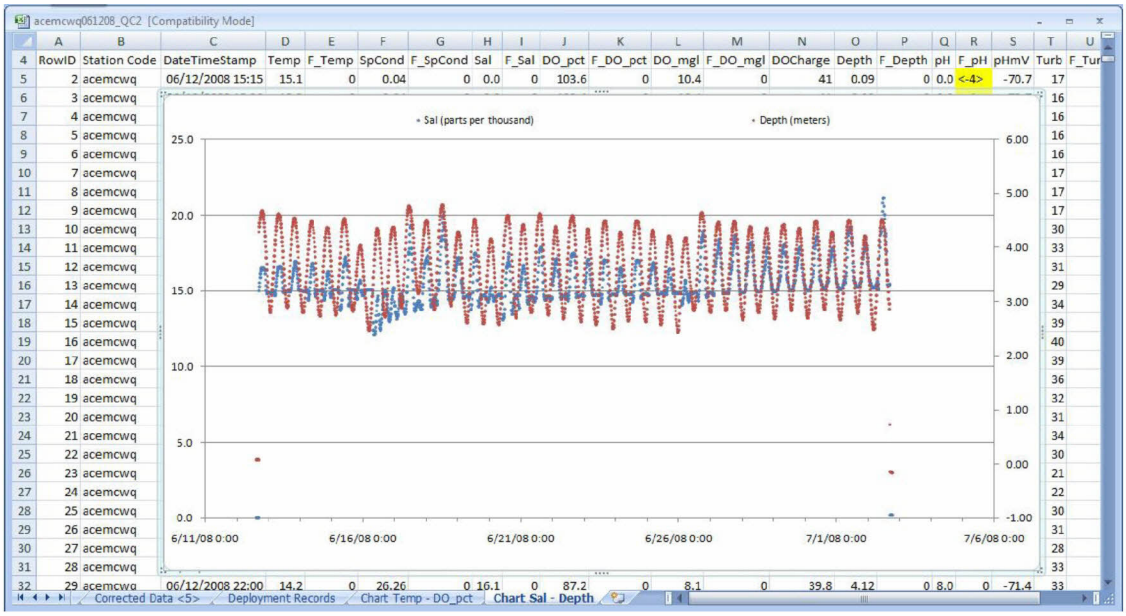


Figure 27. Salinity vs. Depth chart

5) If you have plotted two parameters, you will need to select the second data series in the graph, right click and choose **Format Data Series,** then tab to the **Axis** tab and choose **Plot series on secondary axis**.

6) Once all desired charts have been created, close the **Create Charts** window and the **NERR QAQC Main Menu** to review each chart individually.

7) You may need to make some minor formatting changes to your charts in order to view them better. The macro cannot format charts perfectly in multiple versions of Excel.

    a. In the charts above, the legend has been moved to the top of the chart (click on the legend and drag it to the desired location) and the x-axis dates have been rotated (right click on the x-axis, choose format axis, choose alignment, select horizontal for text direction).

    b. The chart itself can also be resized by selecting the chart (inside the window), "grabbing" a corner, and moving it until the appropriate size has been reached.

8) Inspect each chart and note any questionable data. Mouse over the chart to determine dates/times and data values for problem areas.

    a. If there are any missing data in the file, it will be represented by a gap in the graph. Tab to the missing data metadata sheet for a list of missing records in the file.

    b. Data flagged as rejected or out of sensor range are excluded from charts.

9) Once all questionable data have been identified, continue to the next step, applying flag codes to the data.

IMPORTANT: The charts must be deleted and recreated any time additional flags of less than 0 are applied to the Data sheet or pre- and post-deployment data are removed. In order to mask all data with flags of <0 in the charts, the data had to be filtered and copied into the individual chart sheets, thereby losing its link to the "data" sheet.

Step 4: Apply Flag Codes

The **Apply Flag Codes tool** will allow the user to remove pre- and post-deployment records and document the data by inserting QAQC flags and codes into the parameter flag columns of the dataset. The primary QAQC'd data may have QAQC flags that need to be replaced or further documented with QAQC codes[14].

To launch the **Apply Flag Codes** tool,

1) Click on the **NERR QAQC Main Menu** button in the Excel toolbar.

Figure 28. NERR QAQC main menu

2) Click on the **Step 4: Apply Flag Codes** button.

3) The **Apply Flag Codes** window will open.

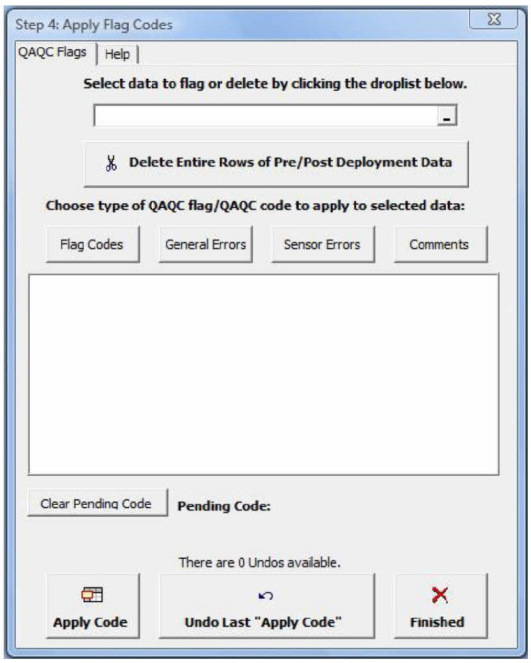


Figure 29. Apply flag codes window

[14] Out of sensor limit flags -5 or -4 must be replaced during secondary QAQC with -3 or 1 flags. QAQC flags other than -2 and 0 must be accompanied by a QAQC code.

Remove pre- and post-deployment data in a WQ file

The **Delete Entire Rows of Pre/Post Deployment Data** tool will facilitate the removal of pre- and post-deployment records from the dataset. Using this tool to remove those records maintains the integrity of the dataset by keeping the data sheet protected and moving the deleted records into their own metadata sheet.

IMPORTANT: No other data values are to be removed from the dataset under any conditions.

Pre- and post-deployment data may or may not have been flagged during primary QAQC. They will only be flagged if the data were out of sensor range.

1) With the **Apply Flag Codes** window open, select the minimize button in the right corner of the **Select data to flag or delete by clicking the droplist below** window.

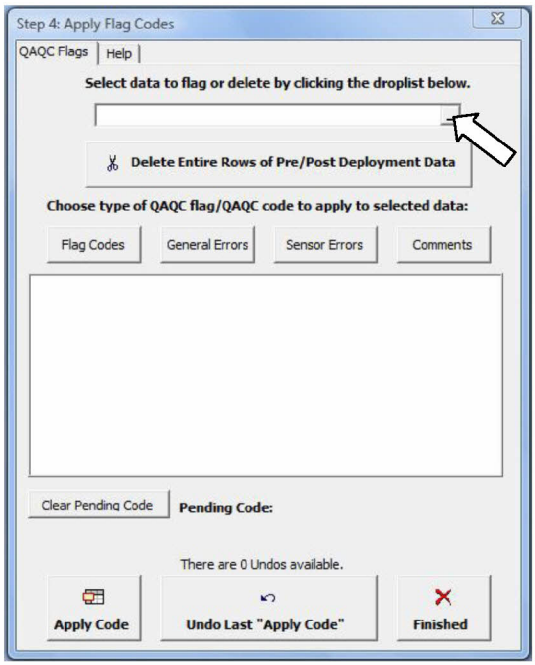


Figure 30. Apply flag codes window

2) When using the data selection tool the **Apply Flag Codes** window will collapse and leave the following data selection window open.

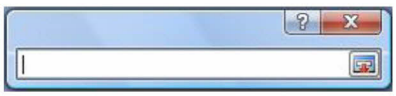


Figure 31. Data selection window

3) Scroll through the **Data** sheet and select the rows of pre- or post-deployment data to be deleted.

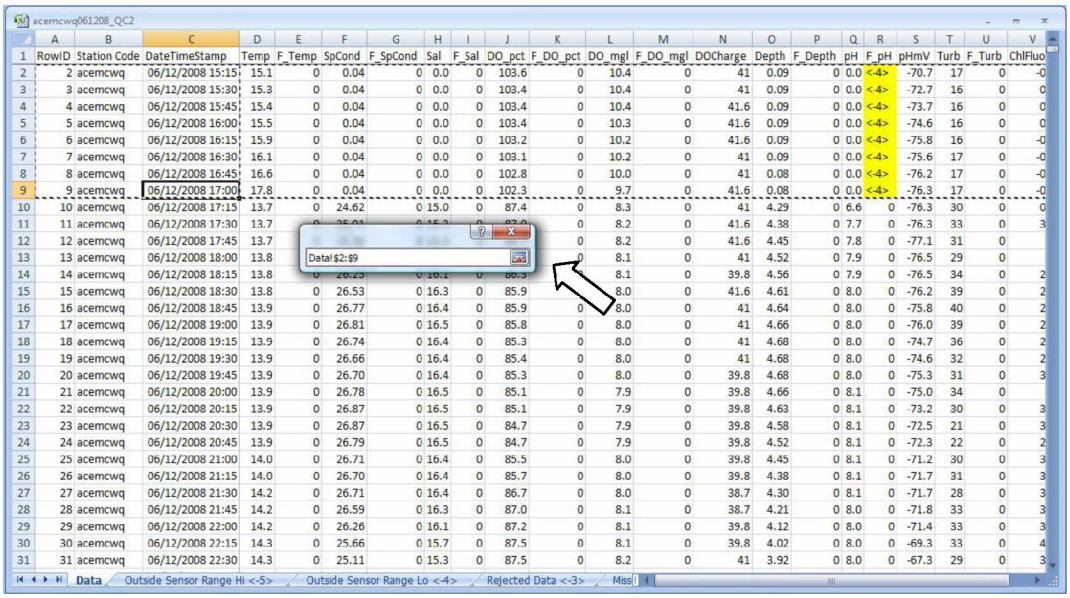


Figure 32. Selecting pre- and post-deployment data to remove

a. Any data selected, whether it is one cell or an entire row will result in the entire record being deleted after using the **Delete Entire Rows of Pre/Post Deployment Data** tool.

a. After making the selection, maximize the data selection window.

4) When the **Apply Flag Codes** window opens, choose the **Delete Entire Rows of Pre/Post Deployment Data** button.

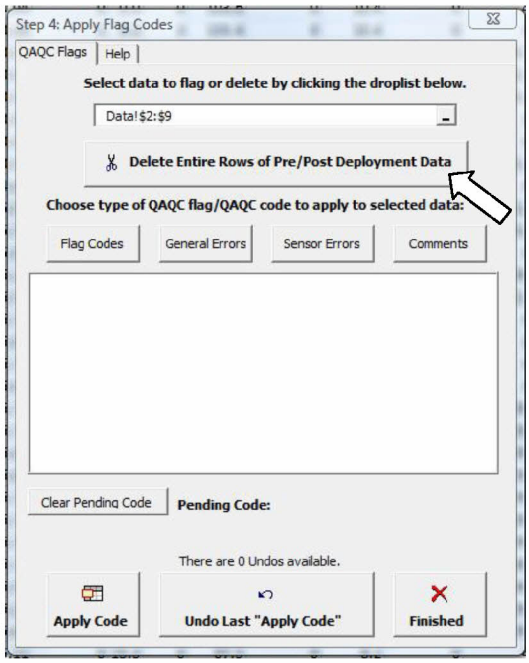


Figure 33. Selecting the delete entire rows of pre- and post-deployment data button

5) A window will appear asking you to confirm that the selected records be removed. Choose **Yes** to have the records moved to the **Deployment Records** metadata sheet. This process creates a record of all deleted pre- and post-deployment data to access later as needed. Choose **No** to cancel out of the operation.

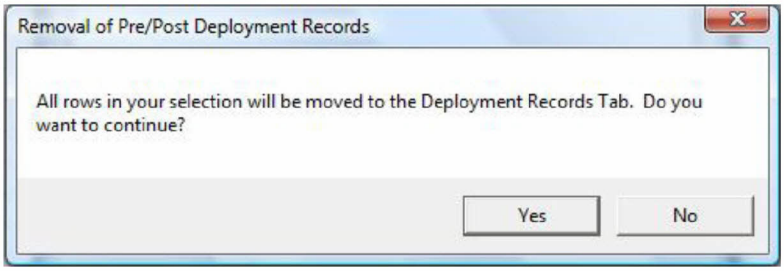
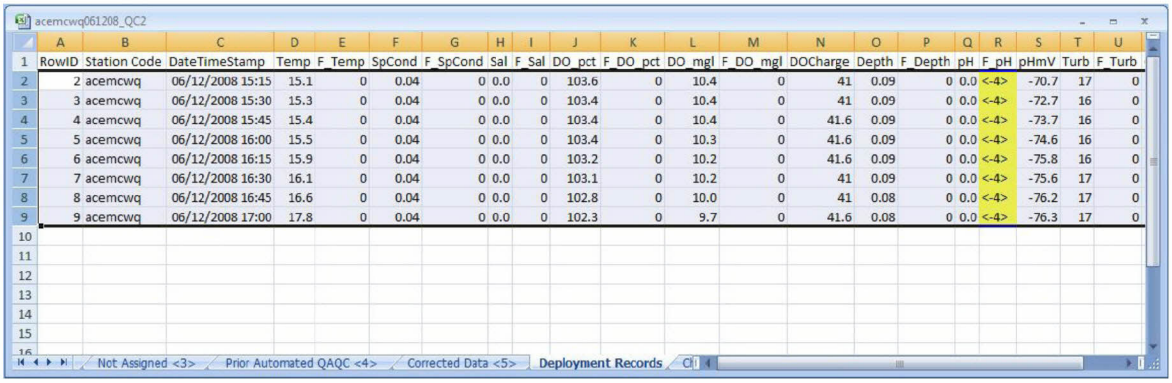


Figure 34. Pre- and post-deployment record removal confirmation

6) Now close the **Apply Flag Codes** and the **NERR QAQC Main Menu** windows and tab to the **Deployment Records** metadata sheet to review the deleted records. If a record has mistakenly been deleted, you can always cut the record(s) out of the **Deployment Records** sheet then insert it into the data sheet. You will have to unprotect the data sheet first[15] then reprotect it when you are finished.


acemcwq061208_QC2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	RowID	Station Code	DateTimeStamp	Temp	F_Temp	SpCond	F_SpCond	Sal	F_Sal	DO_pct	F_DO_pct	DO_mgl	F_DO_mgl	DOCharge	Depth	F_Depth	pH	F_pH	pHmV	Turb	F_Turb
2	2	acemcwq	06/12/2008 15:15	15.1	0	0.04	0	0.0	0	103.6	0	10.4	0	41	0.09	0	0.0	<-4>	-70.7	17	0
3	3	acemcwq	06/12/2008 15:30	15.3	0	0.04	0	0.0	0	103.4	0	10.4	0	41	0.09	0	0.0	<-4>	-72.7	16	0
4	4	acemcwq	06/12/2008 15:45	15.4	0	0.04	0	0.0	0	103.4	0	10.4	0	41.6	0.09	0	0.0	<-4>	-73.7	16	0
5	5	acemcwq	06/12/2008 16:00	15.5	0	0.04	0	0.0	0	103.4	0	10.3	0	41.6	0.09	0	0.0	<-4>	-74.6	16	0
6	6	acemcwq	06/12/2008 16:15	15.9	0	0.04	0	0.0	0	103.2	0	10.2	0	41.6	0.09	0	0.0	<-4>	-75.8	16	0
7	7	acemcwq	06/12/2008 16:30	16.1	0	0.04	0	0.0	0	103.1	0	10.2	0	41	0.09	0	0.0	<-4>	-75.6	17	0
8	8	acemcwq	06/12/2008 16:45	16.6	0	0.04	0	0.0	0	102.8	0	10.0	0	41	0.08	0	0.0	<-4>	-76.2	17	0
9	9	acemcwq	06/12/2008 17:00	17.8	0	0.04	0	0.0	0	102.3	0	9.7	0	41.6	0.08	0	0.0	<-4>	-76.3	17	0
10																					
11																					
12																					
13																					
14																					
15																					

Figure 35. Deployment records metadata sheet

7) Save the Excel workbook using the **Step 6: Save as Excel File** tool.

8) Once all the pre- and post-deployment records have been deleted, continue with secondary QAQC by reopening the **Apply Flags Codes** tool.

[15] To unprotect the worksheet, choose **Tools>Protection>Unprotect Sheet** from the Excel menu.

Apply QAQC flags and QAQC codes to data

The **Apply Flag Codes** tool will facilitate the documentation of the data through the use of QAQC flags and codes. Remember that the QAQC flags and codes that you enter into the dataset act as metadata, therefore you want to be as thorough as possible when choosing a QAQC flag and QAQC code(s) to apply. The data can still be further documented in the Microsoft Word metadata document that will accompany the dataset during submission to the CDMO through the use of the **CSM see metadata** QAQC comment code.

The user will **choose the type of QAQC flag and QAQC code to apply to the selected data** from the following buttons: **Flag Codes**, **General Errors**, **Sensor Errors** and **Comments**. Refer to the QAQC flags and QAQC codes sections for a list of flags and codes to choose from, then choose the most appropriate to apply to the data.

Considerations before applying QAQC flags and codes

Remember that all -4 and -5 QAQC flags must be replaced with a -3, 1, or 5 flag.

Remember that **each -3, 1, or 5 flag must be accompanied by at least one QAQC code, but only one QAQC flag and two QAQC codes are allowed per value.** A general error code cannot be used in combination with a sensor error code and vice versa. However, a comment code can be used in addition to a general error or sensor error code.

When selecting the data, remember that the parameter column and its associated flag column can be selected, rather than just the flag column itself. **Because the parameter columns are protected, QAQC flags and codes will only be entered into the selected flag columns.**

QAQC flags and codes can be applied directly into the **metadata sheets** as well as in the data sheet.

To select contiguous records, select the range of parameter values and their associated flag values. You may select a range of records within the metadata sheet, even though the records are not contiguous in the data file.

To select non-contiguous records, select the first parameter value and its associated flag value then hold down the **Ctrl** key to select the remaining parameter and flag values[16]. Please note that there is a limitation with Excel when selecting non-contiguous records so try to flag data in small increments.

Remember that **General Error** codes are typically applied to an entire record while **Sensor Error** codes are typically applied to the affected sensor only. To further document the value, a **Comment** code can also be applied.

If a **General** or **Sensor Error** code is applied, a secondary QAQC flag should be applied as well.

Applying QAQC flags and codes

1) **Review primary QAQC flags:** Data flagged during primary QAQC should be addressed first.
    a. Records flagged during primary QAQC are automatically copied to the appropriate metadata sheets during the **Enter Station Code** process.

[16] This technique must be used when using the Autofilter function, which also requires that the worksheet be unprotected.

b. Tab through the out of sensor range and missing data metadata sheets to help identify problems with the data.

2) **Review charts for trends and outliers:** Refer to the charts you created and the calibration and log sheets as needed to diagnose problems with the sensors, calibration, etc.

3) When you are ready to document the flagged data with the appropriate QAQC flag or QAQC code, select **Step 4: Apply Flag Codes** from the **NERR QAQC Main Menu**.

4) **Apply secondary QAQC flags and codes:** With the **Apply Flag Codes** window open, select the data to flag by clicking on the minimize button in the **Select data to flag or delete by clicking the droplist below** window shown in the figure below.

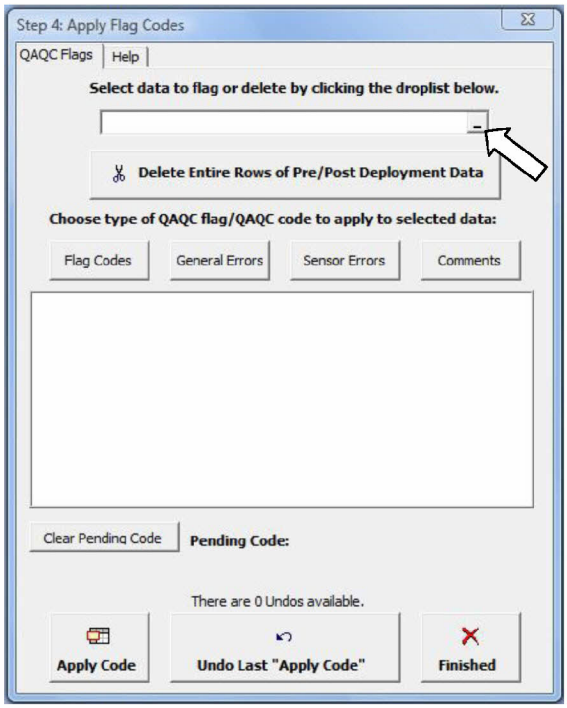


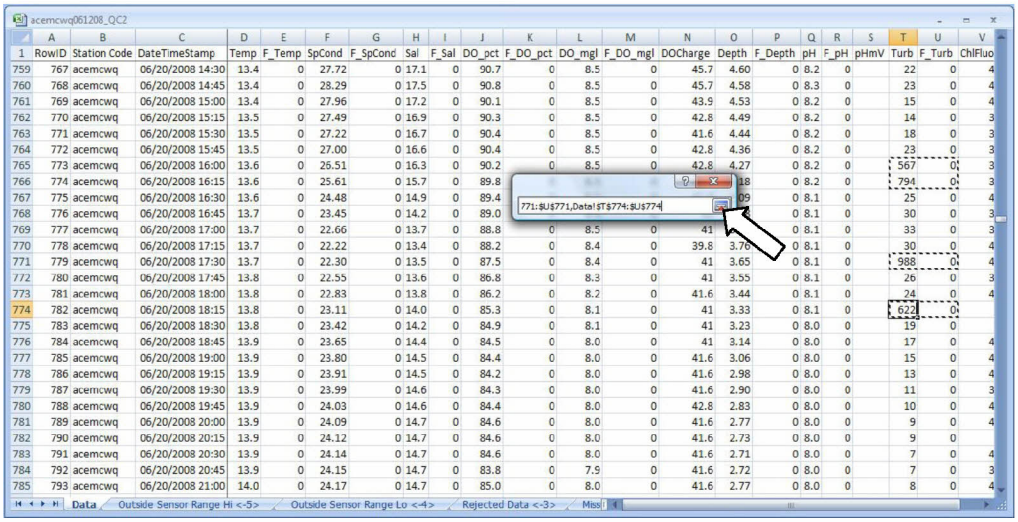
Figure 36. Select data to flag

5) The **Apply Flag Codes** window will collapse and leave the following data selection window open.

Figure 37. Data selection window

6) Select the data to flag in the metadata sheet or the data sheet, then maximize the data selection window to return to the **Apply Flag Codes** window.

a. In the example below, non-contiguous turbidity values of <1000 NTU will be flagged and coded in the data worksheet. Note that values can also be flagged in the metadata sheets.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	RowID	Station Code	DateTimeStamp	Temp	F_Temp	SpCond	F_SpCond	Sal	F_Sal	DO_pct	F_DO_pct	DO_mgl	F_DO_mgl	DOCharge	Depth	F_Depth	pH	F_pH	pHmV	Turb	F_Turb	ChlFluo
759	767	acemcwq	06/20/2008 14:30	13.4	0	27.72	0	17.1	0	90.7	0	8.5	0	45.7	4.60	0	8.2	0		22	0	4
760	768	acemcwq	06/20/2008 14:45	13.4	0	28.29	0	17.5	0	90.8	0	8.5	0	45.7	4.58	0	8.3	0		23	0	4
761	769	acemcwq	06/20/2008 15:00	13.4	0	27.96	0	17.2	0	90.1	0	8.5	0	43.9	4.53	0	8.2	0		15	0	4
762	770	acemcwq	06/20/2008 15:15	13.5	0	27.49	0	16.9	0	90.3	0	8.5	0	42.8	4.49	0	8.2	0		14	0	3
763	771	acemcwq	06/20/2008 15:30	13.5	0	27.22	0	16.7	0	90.4	0	8.5	0	41.6	4.44	0	8.2	0		18	0	3
764	772	acemcwq	06/20/2008 15:45	13.5	0	27.00	0	16.6	0	90.4	0	8.5	0	42.8	4.36	0	8.2	0		23	0	3
765	773	acemcwq	06/20/2008 16:00	13.6	0	26.51	0	16.3	0	90.2	0	8.5	0	42.8	4.27	0	8.2	0		567	0	3
766	774	acemcwq	06/20/2008 16:15	13.6	0	25.61	0	15.7	0	89.8	0			18		0	8.2	0		794	0	3
767	775	acemcwq	06/20/2008 16:30	13.6	0	24.48	0	14.9	0	89.4	0			09		0	8.1	0		25	0	4
768	776	acemcwq	06/20/2008 16:45	13.7	0	23.45	0	14.2	0	89.0	0					0	8.1	0		30	0	3
769	777	acemcwq	06/20/2008 17:00	13.7	0	22.66	0	13.7	0	88.8	0	8.5	0	41		0	8.1	0		33	0	3
770	778	acemcwq	06/20/2008 17:15	13.7	0	22.22	0	13.4	0	88.2	0	8.4	0	39.8	3.76	0	8.1	0		30	0	4
771	779	acemcwq	06/20/2008 17:30	13.7	0	22.30	0	13.5	0	87.5	0	8.4	0	41	3.65	0	8.1	0		988	0	4
772	780	acemcwq	06/20/2008 17:45	13.8	0	22.55	0	13.6	0	86.8	0	8.3	0	41	3.55	0	8.1	0		26	0	3
773	781	acemcwq	06/20/2008 18:00	13.8	0	22.83	0	13.8	0	86.2	0	8.2	0	41.6	3.44	0	8.1	0		24	0	4
774	782	acemcwq	06/20/2008 18:15	13.8	0	23.11	0	14.0	0	85.3	0	8.1	0	41	3.33	0	8.1	0		622	0	
775	783	acemcwq	06/20/2008 18:30	13.8	0	23.42	0	14.2	0	84.9	0	8.1	0	41	3.23	0	8.0	0		19	0	
776	784	acemcwq	06/20/2008 18:45	13.9	0	23.65	0	14.4	0	84.5	0	8.0	0	41	3.14	0	8.0	0		17	0	4
777	785	acemcwq	06/20/2008 19:00	13.9	0	23.80	0	14.5	0	84.4	0	8.0	0	41.6	3.06	0	8.0	0		15	0	4
778	786	acemcwq	06/20/2008 19:15	13.9	0	23.91	0	14.5	0	84.2	0	8.0	0	41.6	2.98	0	8.0	0		13	0	4
779	787	acemcwq	06/20/2008 19:30	13.9	0	23.99	0	14.6	0	84.3	0	8.0	0	41.6	2.90	0	8.0	0		11	0	3
780	788	acemcwq	06/20/2008 19:45	13.9	0	24.03	0	14.6	0	84.4	0	8.0	0	42.8	2.83	0	8.0	0		10	0	4
781	789	acemcwq	06/20/2008 20:00	13.9	0	24.09	0	14.7	0	84.6	0	8.0	0	41.6	2.77	0	8.0	0		9	0	4
782	790	acemcwq	06/20/2008 20:15	13.9	0	24.12	0	14.7	0	84.6	0	8.0	0	41.6	2.73	0	8.0	0		9	0	
783	791	acemcwq	06/20/2008 20:30	13.9	0	24.14	0	14.7	0	84.6	0	8.0	0	41.6	2.71	0	8.0	0		7	0	4
784	792	acemcwq	06/20/2008 20:45	13.9	0	24.15	0	14.7	0	83.8	0	7.9	0	41.6	2.72	0	8.0	0		7	0	3
785	793	acemcwq	06/20/2008 21:00	14.0	0	24.17	0	14.7	0	85.0	0	8.0	0	41.6	2.77	0	8.0	0		8	0	4

Figure 38. Data selected to flag in the data sheet

7) Select the QAQC flag to apply from the **Flag Codes** button. As you make a selection, the pending QAQC codes will be displayed next to the **Pending Code:** in the **Apply Flag Codes** window in red font.

   a. In this example, the turbidity spike data can be flagged with a **<1> Suspect Data** QAQC flag or a **<-3> Data rejected** QAQC flag.

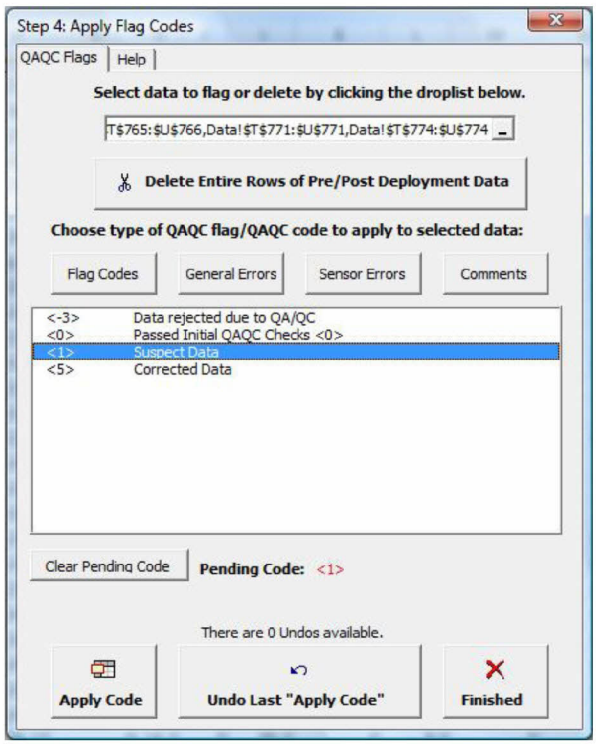


Figure 39. Applying a suspect data flag

8) Next select the appropriate QAQC code or codes to apply from the **General Errors**, **Sensor Errors** and/or **Comments** buttons first. As you make a selection, the pending QAQC codes will be displayed next to the **Pending Code:** in the **Apply Flag Codes** window in red font.

   a. In this example, the turbidity data <1000 NTU will be flagged as a **STS Turbidity Spike** from the list of **Sensor Error** QAQC codes.

   b. Remember that you can apply a **Comment Code** along with a **General** or **Sensor Error Code** to further document conditions or a problem with the data. Comment codes may also be used alone.

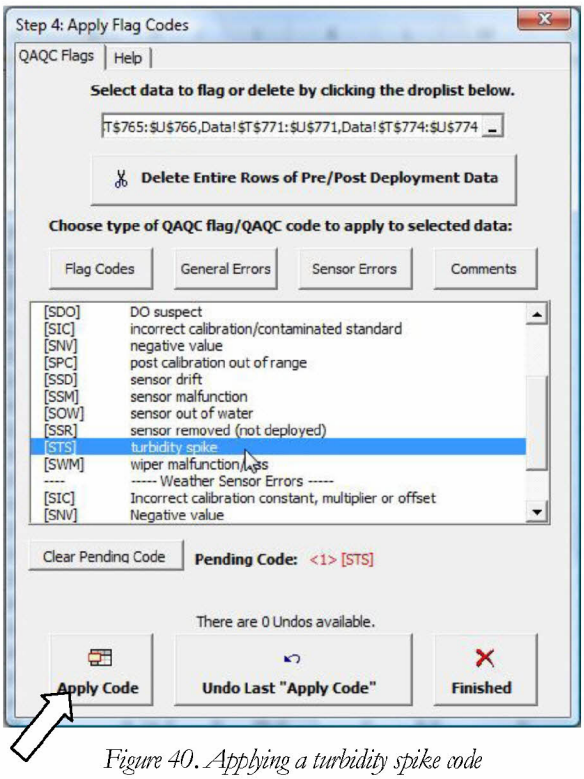
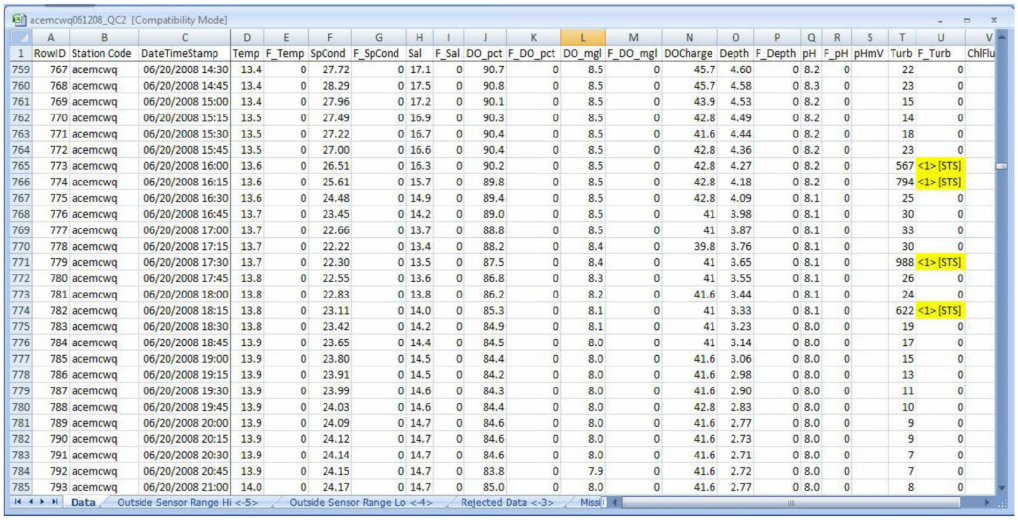


Figure 40. Applying a turbidity spike code

9) As you make the selection from the **Flag Codes**, **General Errors**, **Sensor Errors** and/or **Comments** buttons, you will see the **Pending Codes** change. When you are satisfied with the code to apply, select the **Apply Code** button to have the codes applied to the selected data.

   a. If you need to clear the pending code to make another selection before applying, select the **Clear Pending Code** button.



acemcwq061208_QC2 [Compatibility Mode]

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	RowID	Station Code	DateTimeStamp	Temp	F_Temp	SpCond	F_SpCond	Sal	F_Sal	DO_pct	F_DO_pct	DO_mgl	F_DO_mgl	DOCharge	Depth	F_Depth	pH	F_pH	pHmV	Turb	F_Turb	ChlFlu
759	767	acemcwq	06/20/2008 14:30	13.4	0	27.72	0	17.1	0	90.7	0	8.5	0	45.7	4.60	0	8.2	0		22	0	
760	768	acemcwq	06/20/2008 14:45	13.4	0	28.29	0	17.5	0	90.8	0	8.5	0	45.7	4.58	0	8.3	0		23	0	
761	769	acemcwq	06/20/2008 15:00	13.4	0	27.96	0	17.2	0	90.1	0	8.5	0	43.9	4.53	0	8.2	0		15	0	
762	770	acemcwq	06/20/2008 15:15	13.5	0	27.49	0	16.9	0	90.3	0	8.5	0	42.8	4.49	0	8.2	0		14	0	
763	771	acemcwq	06/20/2008 15:30	13.5	0	27.22	0	16.7	0	90.4	0	8.5	0	41.6	4.44	0	8.2	0		18	0	
764	772	acemcwq	06/20/2008 15:45	13.5	0	27.00	0	16.6	0	90.4	0	8.5	0	42.8	4.36	0	8.2	0		23	0	
765	773	acemcwq	06/20/2008 16:00	13.6	0	26.51	0	16.3	0	90.2	0	8.5	0	42.8	4.27	0	8.2	0		567	<1> [STS]	
766	774	acemcwq	06/20/2008 16:15	13.6	0	25.61	0	15.7	0	89.8	0	8.5	0	42.8	4.18	0	8.2	0		794	<1> [STS]	
767	775	acemcwq	06/20/2008 16:30	13.6	0	24.48	0	14.9	0	89.4	0	8.5	0	42.8	4.09	0	8.1	0		25	0	
768	776	acemcwq	06/20/2008 16:45	13.7	0	23.45	0	14.2	0	89.0	0	8.5	0	41	3.98	0	8.1	0		30	0	
769	777	acemcwq	06/20/2008 17:00	13.7	0	22.66	0	13.7	0	88.8	0	8.5	0	41	3.87	0	8.1	0		33	0	
770	778	acemcwq	06/20/2008 17:15	13.7	0	22.22	0	13.4	0	88.2	0	8.4	0	39.8	3.76	0	8.1	0		30	0	
771	779	acemcwq	06/20/2008 17:30	13.7	0	22.30	0	13.5	0	87.5	0	8.4	0	41	3.65	0	8.1	0		988	<1> [STS]	
772	780	acemcwq	06/20/2008 17:45	13.8	0	22.55	0	13.6	0	86.8	0	8.3	0	41	3.55	0	8.1	0		26	0	
773	781	acemcwq	06/20/2008 18:00	13.8	0	22.83	0	13.8	0	86.2	0	8.2	0	41.6	3.44	0	8.1	0		24	0	
774	782	acemcwq	06/20/2008 18:15	13.8	0	23.11	0	14.0	0	85.3	0	8.1	0	41	3.33	0	8.1	0		622	<1> [STS]	
775	783	acemcwq	06/20/2008 18:30	13.8	0	23.42	0	14.2	0	84.9	0	8.1	0	41	3.23	0	8.0	0		19	0	
776	784	acemcwq	06/20/2008 18:45	13.9	0	23.65	0	14.4	0	84.5	0	8.0	0	41	3.14	0	8.0	0		17	0	
777	785	acemcwq	06/20/2008 19:00	13.9	0	23.80	0	14.5	0	84.4	0	8.0	0	41.6	3.06	0	8.0	0		15	0	
778	786	acemcwq	06/20/2008 19:15	13.9	0	23.91	0	14.5	0	84.2	0	8.0	0	41.6	2.98	0	8.0	0		13	0	
779	787	acemcwq	06/20/2008 19:30	13.9	0	23.99	0	14.6	0	84.3	0	8.0	0	41.6	2.90	0	8.0	0		11	0	
780	788	acemcwq	06/20/2008 19:45	13.9	0	24.03	0	14.6	0	84.4	0	8.0	0	42.8	2.83	0	8.0	0		10	0	
781	789	acemcwq	06/20/2008 20:00	13.9	0	24.09	0	14.7	0	84.6	0	8.0	0	41.6	2.77	0	8.0	0		9	0	
782	790	acemcwq	06/20/2008 20:15	13.9	0	24.12	0	14.7	0	84.6	0	8.0	0	41.6	2.73	0	8.0	0		9	0	
783	791	acemcwq	06/20/2008 20:30	13.9	0	24.14	0	14.7	0	84.6	0	8.0	0	41.6	2.71	0	8.0	0		7	0	
784	792	acemcwq	06/20/2008 20:45	13.9	0	24.15	0	14.7	0	83.8	0	7.9	0	41.6	2.72	0	8.0	0		7	0	
785	793	acemcwq	06/20/2008 21:00	14.0	0	24.17	0	14.7	0	85.0	0	8.0	0	41.6	2.77	0	8.0	0		8	0	

Data | Outside Sensor Range Hi <-5> | Outside Sensor Range Lo <-4> | Rejected Data <-3> | Missi

Figure 41. After applying a turbidity spike code

10) Continue reviewing your data, flagging and coding as necessary.

   a. If you would like to update your metadata sheets to help keep track of the data you have flagged and coded, skip ahead to **Step 5: Synchronize Metadata Sheets**.

   b. You may also want to update your charts (by deleting and recreating them) to reflect data that have been rejected.

11) Exit the flagging tool by choosing the **Finished** button and save the Excel workbook using the **Step 6: as Save Excel File** tool.

Removing QAQC flags and codes

1) If you need to undo a QAQC flag or QAQC code that was applied, use the **Undo Last "Apply Code"** button. You will see a running total of the amount of "Undo" operations available above the **Undo Last "Apply Code"** button. It will keep track of all flags and codes that were entered into the dataset while the file has been open, however if you close the file or open another file to process, the undo operations will be cleared from memory.

2) If you need to remove existing codes that were applied during a previous QAQC session, choose "**Remove existing general error code**" from the General Errors list, "**Remove existing sensor error code**" from the Sensor Errors list, or "**Remove existing comment code**" from the Comment Code list of the **Apply Flag Codes** window.

Step 5: Synchronize Metadata Sheets

Use the **Synchronize Metadata Sheets** tool to copy all data records with newly applied QAQC flags and codes into the appropriate metadata worksheet and update summary statistics. This will facilitate the QAQC process by providing access to all data with a particular flag in one location and help to ensure that all necessary flags are addressed with an appropriate code.

1) Use the **Synchronize Metadata Sheets** tool to synchronize secondary QAQC flags and codes between the data sheet and the metadata sheets. Do this by opening the **NERR QAQC Main Menu** and choosing the **Step 5: Synchronize Metadata Sheets** button. The following window will appear. Choose **Synchronize Now** to proceed.

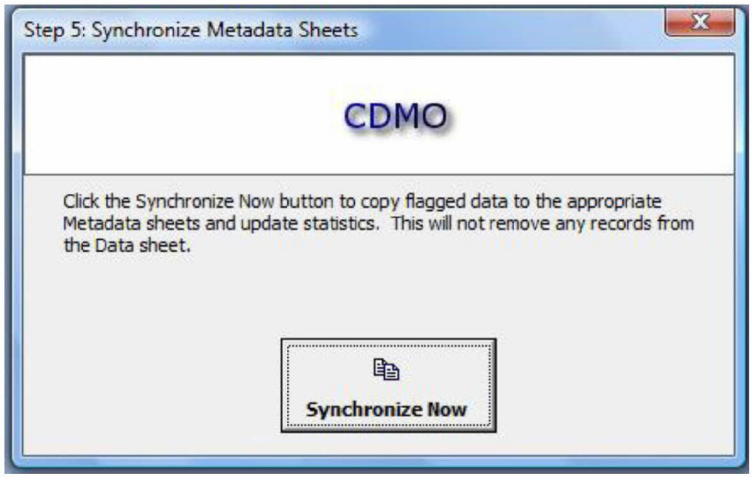


Figure 42. Synchronize metadata sheets

2) Each record containing a flag value other than 0 will be copied into their respective metadata worksheets, as is done automatically during Step 2: Enter Station Code.

   a. Data with flags of 0 will not be copied into the Passed Initial QAQC Checks metadata worksheet unless a comment code has been applied, in which case the flag would change from 0 to <0> and be copied.

   b. Entire records are copied to provide full context for QAQC, not just the parameter with the flagged values.

3) The following window will appear when all records have been copied into their respective worksheets.

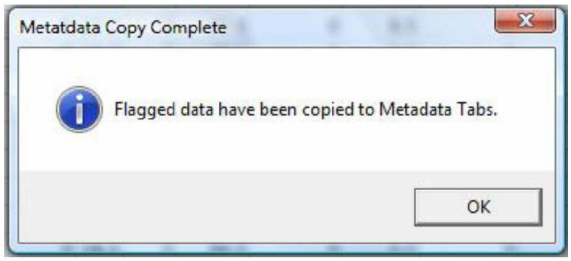
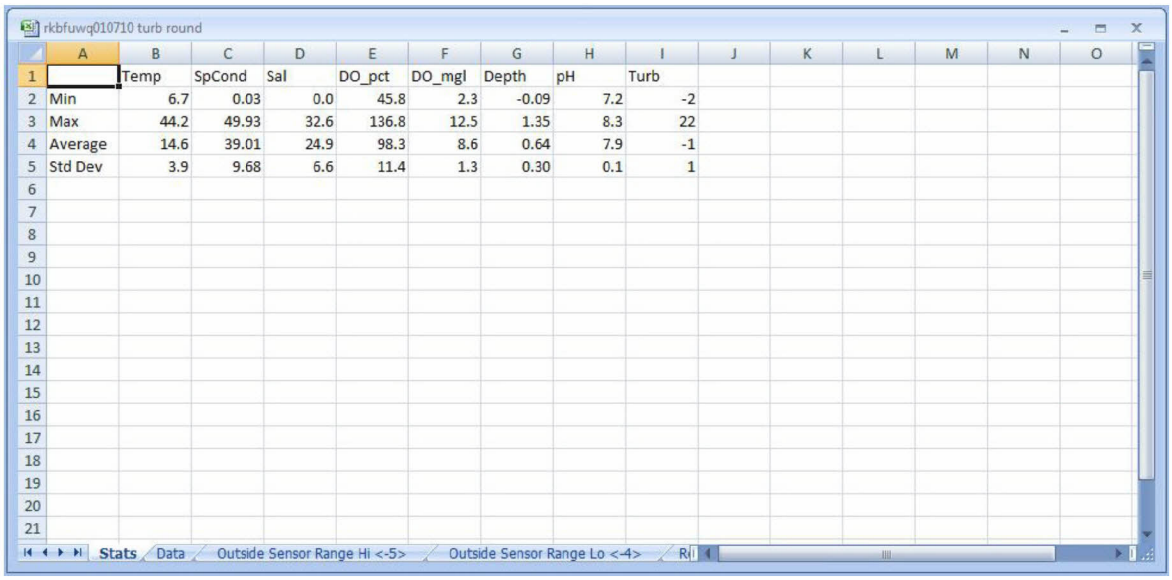


Figure 43. Metadata copy complete window

4) Select the **OK** button. A metadata sheet containing summary statistics will either be created or updated at the first tab. Statistics include min, max, average, and standard deviations and exclude all data with QAQC flags less than zero.

   a. Check statistics page to verify that all outliers have been addressed.

   b. The statistics tool can also be run independently to either create or update the statistics page at any time.



	A	B	C	D	E	F	G	H	I
1		Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
2	Min	6.7	0.03	0.0	45.8	2.3	-0.09	7.2	-2
3	Max	44.2	49.93	32.6	136.8	12.5	1.35	8.3	22
4	Average	14.6	39.01	24.9	98.3	8.6	0.64	7.9	-1
5	Std Dev	3.9	9.68	6.6	11.4	1.3	0.30	0.1	1

Figure 45. Statistics metadata sheet

5) Tab through the metadata sheets looking for any QAQC flags or codes that you may have missed.

   a. Verify that all -4 or -5 flags applied during primary QAQC have been replaced.

   b. Verify that all -3, 1, or 5 QAQC flags are accompanied by at least one QAQC code.

6) When all the desired QAQC flags and codes have been applied, make sure to uses the **Synchronize Metadata Sheets** tool one last time to create a final version of your metadata sheets.

7) Save the Excel workbook using the **Step 6: as Save Excel File** tool. If desired, the metadata sheets can also be copied and pasted into the Microsoft Word metadata document to be submitted with the finalized data to the CDMO.

Step 6: Save As Excel File

This Excel workbook is your working QAQC file. Saving it as an Excel workbook will allow you to continue QAQC on the file at any time, as well as preserve the deployment records metadata sheet. Save the file periodically to avoid losing any of your work.

1) Choose **Step 6: Save as Excel File** from the **NERR QAQC Main Menu** window. The Save As window will appear.

2) Name the data workbook appropriately. Consider using the original QC file name followed by a 2 to indicate secondary QAQC (acemcwq061208_QC2).

3) Navigate to a dedicated directory for Secondary QAQC files, and choose Save.

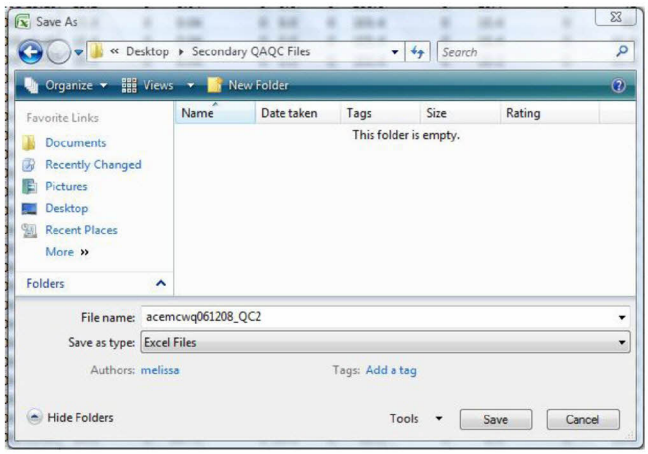


Figure 46. Save as window

4) When your file has been saved, the following window will appear detailing its name and location.

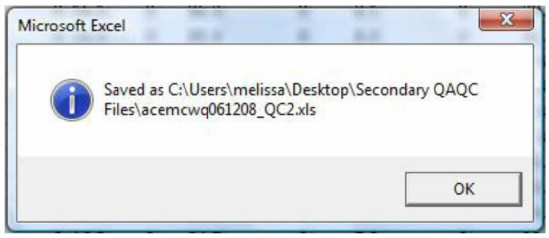


Figure 47. File saved window

Step 7: Append Excel File

For each station, you will need to append your deployment QC files together into quarterly files for quarterly submission and a yearly file for final submission to the CDMO. There are a few things to remember before you begin appending.

You must ensure that there are no overlapping records between deployment files. Remove these records using the "remove pre and post deployment tool" prior to appending.

Quarterly and yearly files must not span multiple years. If your deployment file carries over into the following year, it must be split into the appropriate year for quarterly and yearly file submission. **However, if deployment files span into another quarter, they do not need to be split.**

You may include non-required SWMP parameters such as diagnostic information or optional parameters in the file.

You must ensure each file has the same output order and parameters. If you did not ensure that the parameters were exported from EcoWatch in a consistent order, open each QC file in Excel and shift the columns so that the order is consistent between files, then resave each one.

If you began collecting an optional SWMP supported parameter or including diagnostic information during the quarter or year, you may still include this data. Insert a column and the correct header at the appropriate place in the files missing the parameter. Leave the cells empty. This will ensure file consistency and allow you to include a partial quarter or year of the new parameter data.

Appending deployment or quarterly files.

1) Open the first file you will append to by choosing **Step 1: Open Data File** from the **NERRQAQC Main Menu**.
    a. If you are appending deployment files into quarterly files, open the first deployment file of the quarter.
    b. If you are appending quarterly files into a yearly file, open the first quarter appended file.

2) Choose **Step 7: Append Excel File** from the **NERRQAQC Main Menu**. The open file window will appear. Select the file to be appended to your open file.

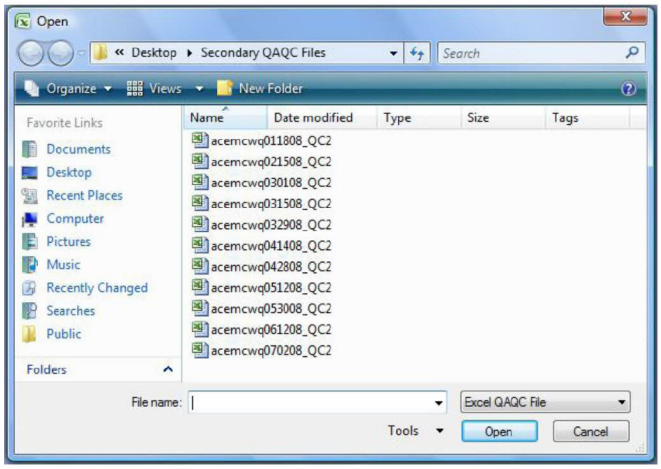


Figure 48. Open file to append window

3) The macro will verify the new file's structure to ensure that it has been through secondary QAQC and formatted by the NERRQAQC macro. Once the file structure has been verified, the following window will appear. Select OK to continue.

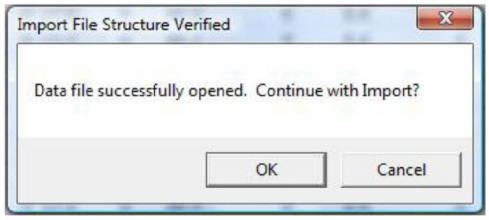


Figure 49. File structure verified window

4) The macro will then check the files for compatibility. If the files are not compatible, the file import will be cancelled.

   a. If the files don't have the same number of parameters, you will receive the following error message.

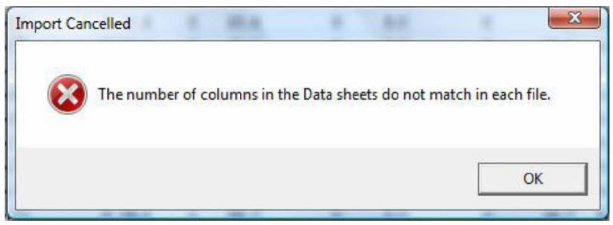


Figure 50. Import cancelled window

   b. If the parameters are not in the same order, you will receive the following error message.

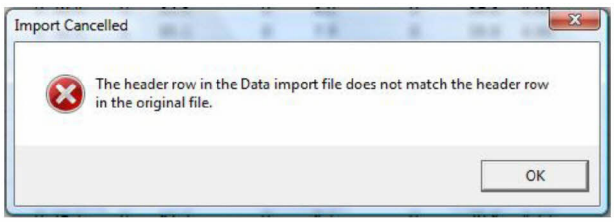


Figure 51. Import cancelled window

   c. If your files have overlapping records, you will receive the following error message.

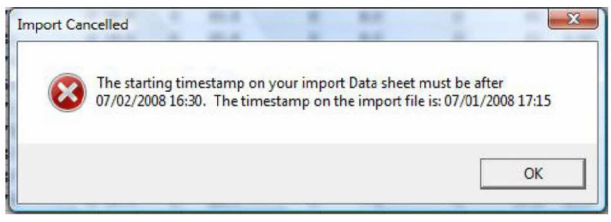


Figure 52. Import cancelled window

d. Return to your files to determine what the problem is and shift parameter columns, remove non-standard diagnostic parameters, add a column for an additional parameter, or remove overlapping deployment data so that your files are compatible.

5) If your files are compatible, the following success window will appear. Select **Yes** and the **Synchronize Metadata Sheets** tool will be launched.

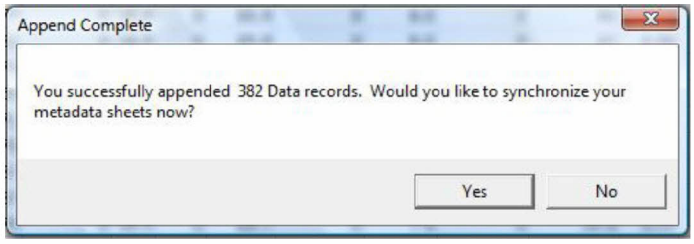


Figure 53. Append complete window

6) Select **Synchronize Now** from the Synchronize Metadata Sheets window and the metadata sheets will be synchronized for the newly appended file.

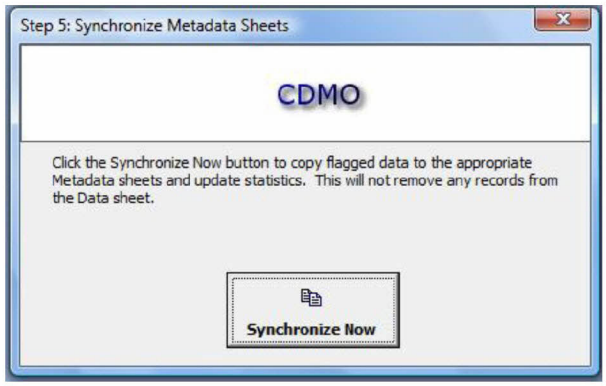


Figure 54. Synchronize metadata sheets window

7) When synchronization is complete, the following success window will appear. Select **OK**.

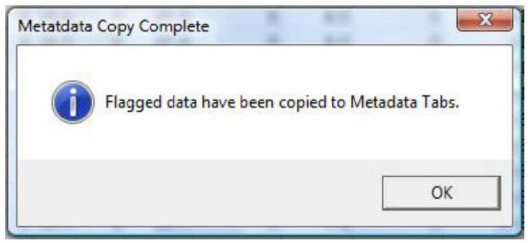


Figure 55. Metadata copy complete window

8) Next the Deployment Records metadata sheet will appear, with a message window indicating how many deployment records have been appended automatically. Select **OK** to return to the **NERRQAQC Main Menu**.

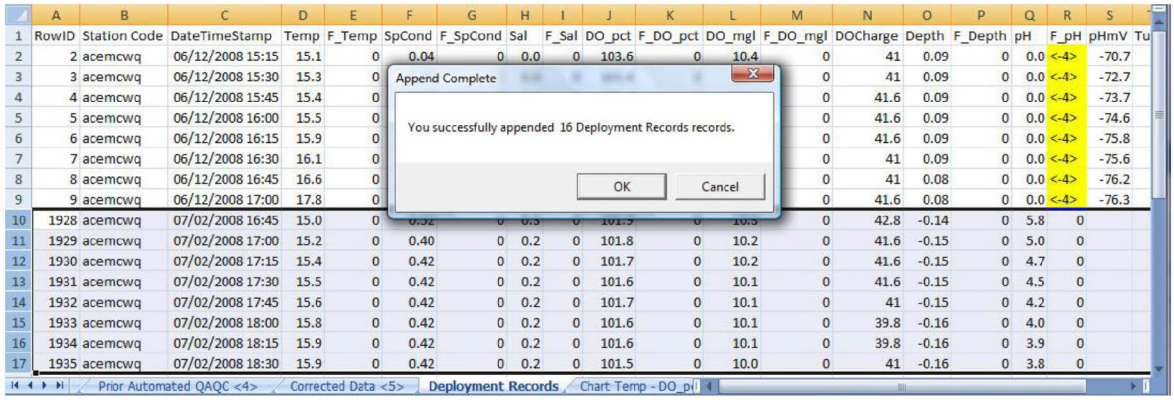


Figure 56. Appended deployment records

9) Close the NERRQAQC Main Menu and scroll through your Data sheet, noting where the new data have been appended. Missing records will be inserted and flagged automatically.

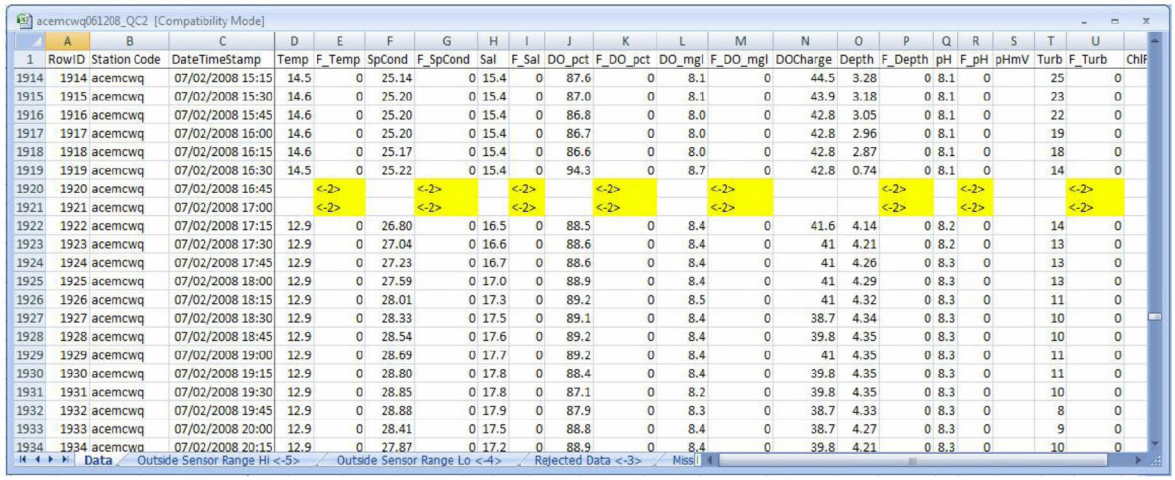


Figure 57. Appended data

10) Go to **Step 6: Save As Excel File** and save your appended file in a dedicated directory for quarterly or yearly files, naming it following the appropriate naming conventions.

   a. For quarterly files, name the file with the 3 letter reserve code, two letter sampling site code, data type code, 4 digit year and Q# (acemcwq2008Q3).

   b. For yearly files, name the file with the 3 letter reserve code, two letter sampling site code, data type code, and 4 digit year (acemcwq2008).

11) The deployment or quarterly file that you just added to your appended file will remain open after your append is complete. Close the file to avoid confusion.

12) Continue appending files until you have compiled a complete quarterly or yearly file, saving the XLS file often throughout the process and when it is complete.

Final review of appended secondary QAQC files

Once you have compiled a complete quarterly or yearly file, open the file in the **NERRQAQC macro** for final review and charting.

1) Open the appended file with the **Step 1: Open Data File** tool.

2) Chart each parameter with the **Step 3: Create Charts** tool. Review the file for new trends and outliers visible with the addition of the new deployment data.

3) Apply additional QAQC flags or QAQC codes to the data with the **Step 4: Apply Flag Codes** tool.

4) Synchronize the metadata and data sheets using the **Step 5: Synchronize Metadata Sheets** tool and verify that all data are flagged and coded properly.

5) Save the final workbook in XLS format using the **Step 6: Save As Excel File** tool.

6) Export the final quarterly or yearly file in CSV format for submission, using the **Step 8: Export CSV File** tool.

Step 8: Export CSV File

After secondary QAQC, appended quarterly and yearly files must be exported as CSV files for submission to the CDMO, where they will be posted as provisional plus data on the CDMO ODIS.

Remember that once exported, the .CSV file should not be edited further with the NERRQAQC macro. If you need to edit the data, you must go back to the final working Excel data workbook to make edits, then re-export the file.

1) When you are ready to export the final QAQC'd file as a comma delimited **.CSV** file, choose the **Step 8: Export CSV File** button from the **NERR QAQC Main Menu**. The export CSV file window will appear.

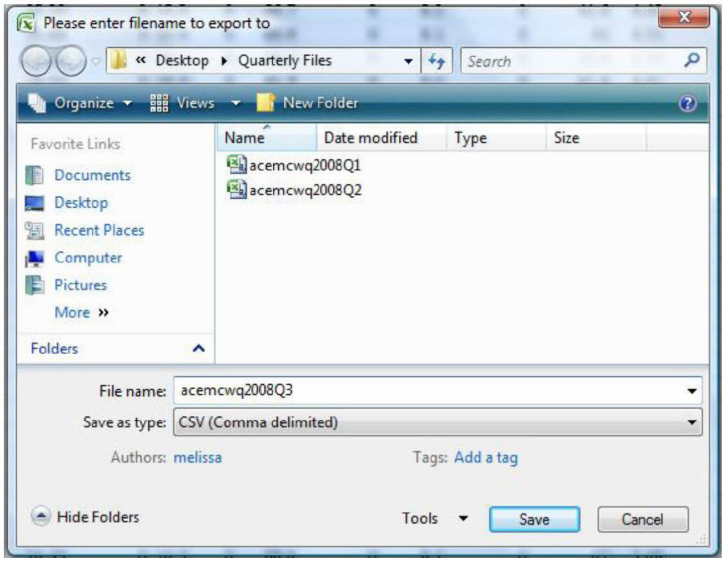


Figure 58. Export .CSV file

2) Save the file to your dedicated directory for quarterly or yearly files. Name the file following the naming conventions required by the CDMO.

   a. Your quarterly or yearly XLS file and exported CSV version of this file should have the same name (other than the file type designation). This will help to avoid confusion if you need to go back to the XLS file to make further edits.

3) The following window will open verifying that the 15-minute records should be exported. Choose **Yes** to export the 15-minute records **required for submission to the CDMO**.

   a. You may re-export the data and choose **No** if you would also like the 30-minute records (only) exported in CSV format for use at the Reserve.

   b. Make sure to name any file containing only 30-minute data appropriately to distinguish it from your complete file.

Figure 59. Export .CSV file

4) Submit the quarterly or yearly exported data file to the CDMO according to the timetable for submission in **Table 1. Secondary QAQC Submission**, located at the beginning of Chapter 4.

   a. Required quarterly file naming convention is the three letter reserve code, two letter station code, four digit year, and Q#. Ex: rkbfuwq2009Q4

   b. Required yearly file naming convention is the three letter reserve code, two letter station code, and four digit year. Ex: rkbfuwq2009

Frequently asked questions

Q: What primary QAQC flags do I have to change?
A: *You must change any out of sensor limits flags (-4 or -5) to suspect or rejected (1 or -3). Any of the discontinued outside 2 or 3 standard deviations from the historical seasonal mean flags (2 or 3) can remain in the data file or be changed to 1 or -3 as appropriate. The CDMO will remove these flags during tertiary review.*

Q: What do I do with the pre- and post-deployment data?
A: *Pre- and post-deployment records are to be removed using the* ***Delete entire rows of pre/post deployment data*** *tool during secondary QAQC, NOT manually. However if you have extensive amounts of pre- and post-deployment data, it can be limited when exporting the raw* ***.CSV*** *file from EcoWatch.*

Q: Why aren't all the data with primary QAQC flag values of 0 being copied into the Passed Initial QAQC Checks metadata worksheet?
A: *Data with flags of 0 will not be copied into the Passed Initial QAQC Checks metadata worksheet unless a comment code has been applied, in which case the flag would change from 0 to <0> and be copied.*

Q: Do all flagged data need to have a QAQC code applied?
A: ***All data flagged as -3, 1, or 5 must have a QAQC code.*** *Choose the most appropriate QAQC code to apply; a general or sensor error and/or a comment code.*

Q: Why won't the macro let me apply a general error and sensor error code into the same cell?
A: *You must choose to apply either a general error code OR a sensor error code, not both. However a comment code can be used in conjunction with either a general or a sensor error code.*

Q: What QAQC flag and QAQC code should I use if I have slightly negative depth data or small negative turbidity values that are flagged as out of sensor range (-4 or -5)?
A: *These data are suspect, but may be acceptable. For turbidity values between 0 and -2, the suspect data <1> QAQC flag and the CAF acceptable calibration/accuracy error QAQC code will be applied automatically by the NERRQAQC macro. This flag code combination should be used where appropriate for other small negative depth or turbidity values.*

Q: Which turbidity spike code should I use?
A: *For turbidity data that are suspect or rejected, use the sensor error code STS. For data that will retain the 0 flag, use the comment code CTS. CTS can also be used as a comment with other parameters.*

Q: How do I change a value if I need to correct it?
A: *You must unprotect the worksheet first by choosing* ***Tools>Protection>Unprotect sheet*** *from the menu then make the change to the data point. Remember to flag that datum with the 5 QAQC flag.*

Q: Do I need to insert missing data records at the beginning or end of the year?
A: *The NERRQAQC macro will only insert missing data records that fall between the first and last record in your data file. During tertiary review, the CDMO will insert missing data records at the beginning or end of the year in order to compile a complete yearly file. If the data are missing due to ice, they will be flagged appropriately with <-2>[GIC].*

Water quality metadata management: metadata documentation

The most important part of data collection is creating the associated data documentation or metadata. Metadata explains all aspects of the data from the research objectives to the data QAQC and should be created as each data set is processed.

The Microsoft Word metadata document that must accompany the dataset will contain a list of all QAQC flags and codes used in the dataset. These embedded flags and codes are an important component of the dataset's metadata. However, since these codes are not always adequate for complete documentation, there will be a section available in the metadata to detail important information about the dataset. Data users may be pointed to the metadata document for these more detailed explanations with the use of the **CSM "See Metadata"** QAQC code. Reserves must use the new metadata templates for 2008 data submission.

Water quality metadata tips

1) The CDMO will not accept any final yearly data submitted without the corresponding metadata.

2) Metadata must document one calendar year of data. Include all YSI sites in one metadata file for each year. Be sure to include any changes to the deployment protocol, maintenance, site changes or calibration procedures with a date that the change occurred.

3) Use the data type code to indicate what type of data the metadata refers to. There are currently three data types: **wq** to indicate water quality data, **met** to indicate meteorological data, and **nut** to indicate nutrient data.

4) Name the metadata document using the filename code that indicates the NERR site and what months and year the metadata document covers. (For example, if the metadata filename is delwq01-12.03m, it tells the CDMO that the file is a water quality metadata file for the Delaware NERR and covers the months of January - December of 2003).

5) List at the top of the metadata document (under the Title) the months that the metadata covers. List the date of the **Latest Update** to the metadata documentation. Every time that the metadata is edited, the date that the last edit took place should be updated at the top of the metadata record.

6) Be sure to update the sensor specification section which includes more detailed information on models used and their respective specifications. This is very important information for any user of the data.

7) Save the metadata file as a **Microsoft Word document** before sending to the CDMO server.

8) Make sure to transfer the metadata file as binary if using FTP client software.

Water quality metadata template

Reserve Name (include 3 letter code here) **NERR Water Quality Metadata**
Months and year the documentation covers
Latest Update: Date that the last edits were made

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons – List the staff members responsible for the design, implementation and continuation of the data set. Include name, title, mailing address, phone number, and email address for the Research Coordinator, SWMP technicians, and person(s) responsible for data management.

2) Entry verification – This section explains how the data were verified (QAQC'd) before being sent to the CDMO to be archived into the permanent database. Specifically, list how your data are acquired, validated, processed, and archived. Mention how your reserve deals with overlapping data, outliers, etc. Use the following statement or modify to fit your Reserve:

> Deployment data are uploaded from the YSI data logger to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. Excessive pre- and post-deployment data are removed from the file prior to upload with up to 2 hours of pre- and post-deployment data retained to assist in data management. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove remaining pre- and post-deployment data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12.

Remember to list the person(s) responsible for data management.

3) Research objectives – Describe briefly the nature of the monitoring program resulting in this data set (for example, control versus impacted site, long term monitoring, spatial or temporal coverage, etc.). Describe the goal or purpose of this research.

4) Research methods – Detail the specifics of all YSI deployments, calibrations, and types of standards used in calibrations, the QAQC of the instruments (with roving data loggers, in-situ samples, etc.) and data collection intervals. If you are reporting chlorophyll fluorescence data, include a statement detailing your methodology and initial QA/QC of this parameter, including verification of accuracy and a disclaimer addressing the difficulties in estimating chlorophyll with fluorescence data. If you are reporting level data, detail how and when vertical control was achieved at your sample site(s). Include the following or similar excerpt (modify for additional real-time sites) regarding real-time data:

> A Sutron Sat-Link2 transmitter was installed at the (*insert station name*) station on mm/dd/yy and transmits data to the NOAA GOES satellite, NESDIS ID #XXXXXXXX. (Where XXXXXXXX is the GOES ID for that particular station.) The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen

minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at http://cdmo.baruch.sc.edu.

5) Site location and character – Describe your NERR site in general and the sampling sites associated with each YSI data logger. Include the following in your description for each sampling location. If certain characteristics apply to all sample sites or the entire Reserve they may be discussed in an overview:

a) latitude and longitude
b) tidal range
c) salinity range
d) type and amount of freshwater input
e) water depth (mean depth or depth range at site, NOT depth of sonde deployment)
f) bottom habitat or type (soft sediment, grassbed, oyster bar, etc)
g) pollutants in area
h) description of watershed draining site

6) Data collection period – Include each YSI deployment and retrieval date and time (**first** and **last** readings in the water) for each monitoring site for the year. Do not include times of pre- and post-deployment or datasondes' transport. Note when data collection began initially for your Reserve or sample sites.

7) Distribution – This section will address data ownership and data liability by including the following excerpt from the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program in the metadata.

> NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Also include the following excerpt in the metadata which will address how and where the data can be obtained.

> NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see

personnel directory under the general information link on the CDMO home page) and online at the CDMO home page http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format.

8) Associated researchers and projects (link to other products or programs) – Describe briefly other research (data collection) that correlates or enhances the data collected by data loggers. At a minimum, mention the SWMP MET and NUT data sets.

II. Physical Structure Descriptors

9) Sensor specifications – Include the parameter description, units, sensor type, model #, range of measurement, accuracy and resolution for each sensor for all measuring devices (6000, 6600, 6600 EDS, 6600 EDS V2, or 6600 V2). ***Specify if all of your sondes are the same model and have the same configuration. If not, detail how many of each model you have, what different sensor configurations you use, and where the different models/configurations are deployed.*** See the following example and include the disclaimers below.

Example: DEL NERR deployed only 6600EDS data sondes in 2008. Rapid-pulse DO sensors were deployed at sites SL and LL through 6/1/08. ROX DO sensors were deployed at SL and LL for the remainder of 2008 and at BL and DS for all of 2008.

YSI 6600EDS data sonde:

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Thermistor
Model#: 6560
Range: -5 to 50 C
Accuracy: +/- 0.15
Resolution: 0.01 C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: 4-electrode cell with autoranging
Model#: 6560
Range: 0 to 100 mS/cm
Accuracy: +/- 0.5% of reading + 0.001 mS/cm
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity
Units: parts per thousand (ppt)
Sensor Type: Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater
Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation
Units: percent air saturation (%)
Sensor Type: Rapid Pulse - Clark type, polargraphic
Model#: 6562
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: +/- 2% of the reading or 2% air saturation, whichever is greater;
200 to 500% air saturation: +/- 6% of the reading
Resolution: 0.1% air saturation

or

Sensor Type: Optical probe w/ mechanical cleaning
Model#: 6150 ROX
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater
200-500% air saturation: +/- 15% or reading
Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)
Units: milligrams/Liter (mg/L)
Sensor Type: Rapid Pulse - Clark type, polargraphic
Model#: 6562
Range: 0 to 50 mg/L
Accuracy: 0-20 mg/L: +/- 2% of the reading or 0.2 mg/L, whichever is greater
20 to 50 mg/L: +/- 6% of the reading
Resolution: 0.01 mg/L

or

Units: milligrams/Liter (mg/L)
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 6150 ROX
Range: 0 to 50 mg/L
Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater
20 to 50 mg/L: +/- 15% of the reading
Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)
Units: feet or meters (ft or m)
Sensor Type: Stainless steel strain gauge
Range: 0 to 30 ft (9.1 m)
Accuracy: +/- 0.06 ft (0.018 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe or EDS flat glass probe
Units: pH units
Sensor Type: Glass combination electrode
Model#: 6561 or 6561FG
Range: 0 to 14 units
Accuracy: +/- 0.2 units
Resolution: 0.01 units

Parameter: Turbidity
Units: nephelometric turbidity units (NTU)
Sensor Type: Optical, 90 degree scatter, with mechanical cleaning
Model#: 6136
Range: 0 to 1000 NTU
Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)
Resolution: 0.1 NTU
Parameter: Chlorophyll Fluorescence
Units: micrograms/Liter
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 6025
Range: 0 to 400 ug/Liter
Accuracy: Dependent on methodology
Resolution: 0.1 ug/L chl a, 0.1% FS

Include the following DO (unless ALL your sondes are EDS or have the ROX Optical DO sensor) and Depth data disclaimers:

Dissolved Oxygen Qualifier:
The reliability of the dissolved oxygen (DO) data after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Many reserves have upgraded to the YSI 6600 EDS data sondes, which increases DO accuracy and longevity by reducing the environmental effects of fouling. The user is therefore advised to consult the metadata and to exercise caution when utilizing the DO data beyond the initial 96-hour time period. However, this potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. The Research Coordinator at the specific NERR site should be contacted concerning the reliability of the DO data because of the site and seasonal variation in the fouling of the DO sensor.

Depth Qualifier:
The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either depth or water level sensors. Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements. Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.03 cm for every 1 millibar change in atmospheric pressure, and is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg). To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or Digital Calibration Log. This offset procedure standardizes each depth calibration for the entire NERR System. If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR site can be corrected. The Research Coordinator at

the specific NERR site should be contacted in order to obtain information regarding atmospheric pressure data availability.

10) Coded variable definitions – List the sampling station, sampling site code, and station code used in the data.

Sampling station:	Sampling site code:	Station code:
Sengstacken Arm	SE	sossewq
Winchester Arm	WI	soswiwq
Valino Island	VA	sosvawq
Charleston Bridge	CH	soschwq

11) QAQC flag definitions – This section details the automated and secondary QAQC flag definitions. Include the following excerpt:

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5	Outside High Sensor Range
-4	Outside Low Sensor Range
-3	Data Rejected due to QAQC
-2	Missing Data
-1	Optional SWMP Supported Parameter
0	Data Passed Initial QAQC Checks
1	Suspect Data
2	*Open - reserved for later flag*
3	*Open - reserved for later flag*
4	Historical Data: Pre-Auto QAQC
5	Corrected Data

12) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point.

General Errors

- GIC No Instrument Deployed Due to Ice
- GIM Instrument Malfunction
- GIT Instrument Recording Error; Recovered Telemetry Data
- GMC No Instrument Deployed Due to Maintenance/Calibration
- GNF Deployment Tube Clogged / No Flow

GOW	Out of Water Event
GPF	Power Failure / Low Battery
GQR	Data Rejected Due to QA/QC Checks
GSM	See Metadata

Sensor Errors

SBO	Blocked Optic
SCF	Conductivity Sensor Failure
SDF	Depth Port Frozen
SDO	DO Suspect
SDP	DO Membrane Puncture
SIC	Incorrect Calibration / Contaminated Standard
SNV	Negative Value
SOW	Sensor Out of Water
SPC	Post Calibration Out of Range
SSD	Sensor Drift
SSM	Sensor Malfunction
SSR	Sensor Removed / Not Deployed
STF	Catastrophic Temperature Sensor Failure
STS	Turbidity Spike
SWM	Wiper Malfunction / Loss

Comments

CAB	Algal Bloom
CAF	Acceptable Calibration/Accuracy Error of Sensor
CAP	Depth Sensor in Water, Affected by Atmospheric Pressure
CBF	Biofouling
CCU	Cause Unknown
CDA	DO Hypoxia (<28% sat)
CDB	Disturbed Bottom
CDF	Data Appear to Fit Conditions
CFK	Fish Kill
CIP	Surface Ice Present at Sample Station
CLT	Low Tide
CMC	In Field Maintenance/Cleaning
CMD	Mud in Probe Guard
CND	New Deployment Begins
CRE	Significant Rain Event
CSM	See Metadata
CTS	Turbidity Spike
CVT	Possible Vandalism/Tampering
CWD	Data Collected at Wrong Depth

13) Post deployment information – Use this section for documentation of post calibration information for instruments deployed at each site. ***At a minimum, include: Date, SpCond, DO%, pH (7), and Turb (0 NTU).*** Depth and additional pH and Turb post cal information are also beneficial.

14) Other remarks/notes – Use this section for further documentation of the research data set. Include any additional notes regarding the data set in general, circumstances not covered by the flags and comment codes, or specific data that were coded with the CSM "See Metadata" comment code. You

may include the metadata worksheets here if so desired. You may also include information on major storms or precipitation events that could have affected the data recorded at the sample sites. Include the following excerpt:

> Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for "not a number" and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Formatting the water quality metadata

1) After completing the final version of the metadata documentation, select **Save as** under the **File** menu.

2) In the **File name** subwindow, type in a new filename for the text file. Name the metadata document with the following filename code that indicates the NERR site, the data type and what months and year the metadata document covers: use the three letter NERR site code, **the data type code (wq=water quality),** the months this metadata covers in two digit numerical code separated by a dash, a period followed by the two digit year code and an "m" to indicate this is a metadata file. Please use all lowercase when naming the file. *For example, if the metadata filename is nocwq01-12.03m, it tells the CDMO that the file is a water quality metadata file for NOC NERR and covers the months of January - December of 2003.*

3) In the **Save as type** subwindow, select **Word Document (*.doc)**.

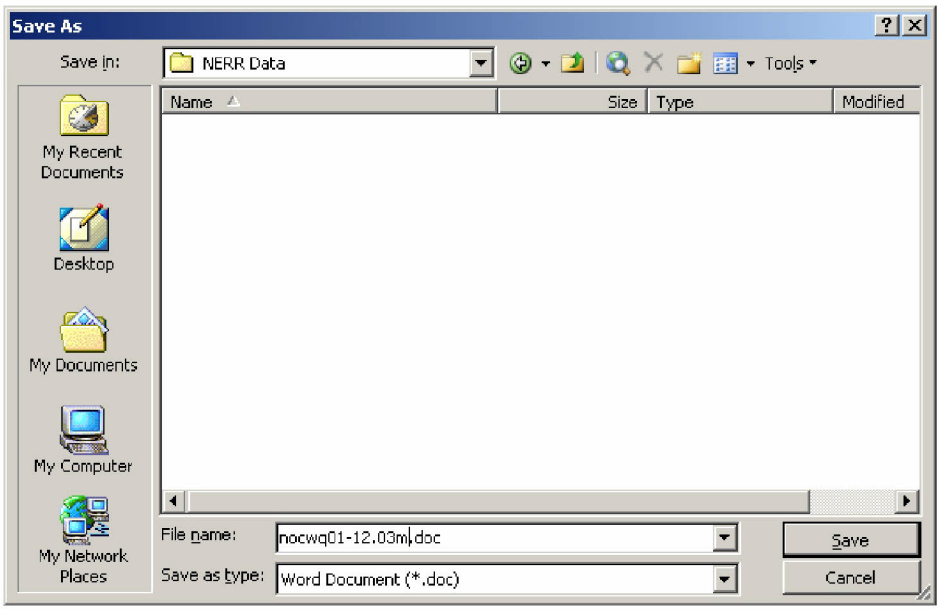


Figure 60. Saving the metadata in Word format.

4) Make sure to select **Binary** in the WS_FTP application before sending to the CDMO.

Water quality data management: data submission

Submission of final data

Final submission of water quality data

Reserves must submit the following files to the CDMO by **March 15** of the subsequent year for data submission to be considered complete.

(1) The raw, completely unchanged .DAT files.

(2) The yearly secondary QAQC'd data files.

(3) The digital calibration and field logs.

(4) The metadata document accompanying the dataset.

Reserves will upload the yearly secondary QAQC'd data files to the CDMO data submission page at **http://cdmo.baruch.sc.edu/DataUpload/index.cfm** and place the digital calibration and field logs, metadata files and raw **.DAT** files on the CDMO FTP server (ftp://ftpcdmo.baruch.sc.edu) in the appropriate Reserve's directory. Notify the CDMO when you've completed this process for verification that your submission is complete.

Summary of steps for handling the water quality files

1) It is most important to virus check all of the files and metadata before sending it to the CDMO FTP server. See Appendix A for recommended virus protection software.

2) Download the raw **.DAT** file from the datasonde and visually check data with EcoWatch. Note the pre- and post-deployment dates and times.

3) Upload the exported raw **comma delimited** file from EcoWatch to the CDMO data submission page for automated primary QAQC.

4) Open the primary QAQC'd file emailed from the CDMO with the **NERRQAQC macro** to conduct secondary QAQC.

5) Enter the station code, chart the data and apply QAQC flags and codes as necessary.

6) Append secondary QAQC'd files together to create quarterly files for each sampling station.

7) Conduct another review of the appended quarterly files using the NERRQAQC macro, adding QAQC flags and codes as necessary.

8) Export the quarterly secondary QAQC'd files in **.CSV** format and submit the files to the CDMO via the data submission web page (http://cdmo.baruch.sc.edu/DataUpload/index.cfm) for posting as provisional plus data, following the timetable in Table 4.

9) Append the quarterly QAQC'd files together to create one yearly file for each sampling station. Conduct one final review of the data using the **NERRQAQC macro**.

10) Export the final yearly files in **.CSV** format and submit the files to the CDMO via the data submission webpage at **http://cdmo.baruch.sc.edu/DataUpload/index.cfm**. Ensure the

CDMO file naming convention is used: three letter **Reserve** code, two letter sampling site code, data type code and four digit year.

11) Complete the final yearly metadata file and submit it to the CDMO server by placing it in the **water quality/metadata** directory on the CDMO FTP site. Ensure the CDMO file naming convention is used: three letter **Reserve** code, the data type code, the months the metadata covers in two digit numerical code, followed by the two digit year code and an "m" to indicate this is a metadata file

12) Submit the completed digital calibration and field logs placing it in the **water quality/digital logs** directory on the CDMO FTP site. Name each file and worksheet as detailed in the "Digital Data Sheets Procedures" document.

13) Submit the raw **.DAT** files placing them in the **water quality/data/raw** *current year* directory.

The process of data acquisition, primary QAQC, secondary QAQC, metadata documentation and data submission is now complete.

Water quality data management: data archival

Refer to Chapter 1: Preparation for data management for data backup and archival tips.

It is recommended to backup and archive the following files created during the QAQC process:

(1) Raw **.DAT** files from the YSI datasonde
(2) Raw **.CSV/.CDF** files exported from EcoWatch
(3) Primary QAQC'd **.CSV/.CDF** files emailed from the CDMO
(4) Secondary QAQC'd **.XLS deployment** workbooks
(5) Quarterly appended QAQC'd **.XLS** workbooks and exported **.CSV** files
(6) Final yearly appended QAQC'd **.XLS** workbook and exported **.CSV** files
(7) Final metadata **.DOC** file
(8) All digital calibration and field log **.XLS** files

Updating the historical database in EQWin

You can continue to add the final yearly data files to the local historical SWMP database in EQWin. This will serve three purposes:

(1) To backup the data
(2) To keep the local historical database updated
(3) To use EQWin's querying, reporting and exporting tools to satisfy data queries or to use in reports or presentations

If you want to update data to the local historical SWMP data in EQwin, follow these steps and refer to the CDMO NERR SWMP Data Management Manual version 5.2 for detailed instructions on using EQWin software.

1) Open the final appended QAQC'd **.XLS** file in Excel.
2) You will have to split apart the datetimestamp into a date and a time column.
    a. To do this, copy the datetimestamp column, select the next column where you want to copy to and choose **Insert Copied Cells** to copy it. Do this once more so that you will have three datetimestamp columns.
    b. Select the second datetimestamp column and format it as **mm/dd/yyyy** from the **Format Cells** menu. Rename that column **"Date"**.
    c. Select the third datetimestamp column and format it as **hh:mm** from the **Format Cells** menu. Rename that column **"Time"**.
    d. Now delete the first datetimestamp column.
3) Copy the contents of the worksheet.
4) Open the historical EQWin database and paste the data from the altered **.XLS** file into a blank **.EQI** file.
5) Delete the **RowID** column and all flag columns from the **.EQI** file.
6) Configure the **.EQI** file and set field A2 as **First station code**, set field B2 as **Date collected**, set field C2 as **Time collected**, and set field D1 as **First parameter code**.
7) Check the data and update it to the database.

Chapter 5

Water Quality Data Review and Editing Protocol

This document[17] was produced by Mike Lizotte and John McDonald of YSI Inc. and Ginger Ogburn-Matthews former NERR CDMO data manager. It was revised by Tammy D. Small, NERR CDMO manager and Mike Lizotte in 2003. A second revision was completed in 2008.

Introduction

The following document has been prepared to aid users of the YSI 6600 in ascertaining the reliability of the data from their deployments. The primary purpose of the document is to provide guidelines for determining what portions of data records should be included in the overall NERR System-wide Monitoring Program's (SWMP) datasonde database, and which should be rejected. The document is designed as a supplement to the "YSI 6-Series Multi-Parameter Water Quality Monitoring Standard Operating Procedure" version 4.1... Our recommendations, which follow, will be dependent on the performance of post deployment sensor performance and drift checks as outlined in the previous document.

This document is clearly not designed to be the final word on the data review and editing issue, but instead to simply be a starting point for consideration, rejection, and modification by the NERR System-wide Monitoring Program as more experience is acquired and more data are generated and processed.

The general philosophy for data acceptance or rejection will be based on absolute and discretionary factors.

(1) **absolute:** In the first phase of data review and editing, values sometimes can be rejected on the basis of absolute factors with no detailed analysis of the study by the NERR Research Coordinator (RC) or Datasonde Manager at each site.
(2) **discretionary:** These are other instances in which the data must be examined before absolute rejection. In the second phase, each deployment study must be evaluated at the site for anomalies prior to submission of data for inclusion in the NERR SWMP's water quality datasonde database.

Absolute data rejection (1)

The value recorded in the datasonde memory is outside the listed range specifications of the instrument. Automated primary QAQC provided by the CDMO automatically flags values that are outside of sensor specifications for further review by the Reserve.

[17] Produced by Mike Lizotte and John McDonald of YSI Inc. and Ginger Ogburn-Matthews former NERR CDMO data manager. Revised by Tammy D. Small, NERR CDMO manager and Mike Lizotte in 2003. Second revision in 2008.

The following criteria are based on the latest YSI 6-Series Environmental Monitoring Systems Operating Manual sensor specifications (www.ysi.com) and are what the NERR CDMO automated primary QAQC criteria are based on.

Temperature: -5 to 50 °C
Specific Conductivity: 0 to 100 mS/cm
Salinity: 0 to 70 ppt
Dissolved Oxygen (% Saturation): 0 to 500 % air saturation
Dissolved Oxygen (mg/L): 0 to 50 mg/L
Shallow Depth: 0 to 9.1m
pH: 0 to 14 units
Turbidity: 0 to 1000 NTU

Always reject data that are outside of the range of the probes; the only exceptions to the absolute data rejection for out-of-range values are for the Shallow depth and Turbidity probes. These exceptions are explained under their respective headings in this document.

Absolute data rejection (2)

Examination of the data record indicates that some or all of the sensors were out of the water due to:

(1) An unexpected tidal fluctuation,
(2) An improperly deployed datasonde, or
(3) Times of pre- and post-deployment when transporting the datasonde.

An unexpected tidal fluctuation or an improperly deployed datasonde: Usually these situations will be indicated by a **very low (near zero) or a very sharp decline in conductivity** readings even when the unit is known to be at a site characterized by brackish water. This effect is demonstrated in Figure 1A where it is evident that the water level has dropped below the conductivity sensor on several occasions. In the study associated with Figure 1B, the datasonde seemingly came out of the water midway through the study and remained there.

Reject all of the data in these areas of the data record, not just conductivity/salinity because it is impossible to tell whether the other sensors were in the water at the time of measurement.

Times of pre- and post-deployment when transporting the datasonde: Figure 2 and the beginning of Figure 4 show that the beginning and end (tails) of data (pre- and post-deployment) are not in range of the other readings. Note that the time on the datasonde is not always the same as what is on your watch, especially during daylight savings. Remember that any data collection including that of the datasondes should be recorded in standard time only NOT daylight savings time.

All data should be examined for these types of data, and the tails should be rejected from the deployment record.

Absolute data rejection (3)

All probes will register a value even if there is no sensor installed on the datasonde.

This is a situation that cannot be replicated (for example, the motherboard does not always register the same values when the sensors are missing).

Always reject data for sensors that have not been installed. Always document when you are missing a sensor for each deployment.

Other absolute data rejection (4)

In time, experience may indicate other absolute data rejection criteria.

Discretionary data rejection

In this part of the procedure, data analysis of all recorded parameters should be carried out by or under the supervision of the site Research Coordinator. If anomalies are observed, that data may be marked as suspect and documented or rejected and documented at the discretion of the Research Coordinator.

Data review and editing should take place as soon as possible after datasonde recovery so that the details of the deployment will be fresh in the minds of the site personnel and if anomalies are found, corrective action can be attempted prior to the next deployment. Immediately after recovery of the datasonde, both YSI and the CDMO recommend an upload of the data file in the PC6000 format followed by cursory analysis of the data using the plotting function of the YSI-supplied PC6000 software or EcoWatch. This action will provide insight into whether problems occurred with any of the sensors during deployment, which might be grounds for rejection of portions of the data.

All PC6000 files should be archived at the individual sites. These files are basically inviolate since it is unlikely that the average user will have the knowledge to delete any entries from the PC6000 format. Therefore all data records (good and suspect) will be present. Also PC6000 (.dat) files can always be used to export comma-delimited files using EcoWatch or PC6000 software.

In the discretionary evaluation of the data, each sensor should be evaluated individually. Usually the evaluator should be looking for a discontinuity (sudden jumps high or low - to out of range values or other anomalies) in the data, which indicates a sensor has failed catastrophically during the deployment. This type of failure can be either reversible (torn membrane on the dissolved oxygen probe, for example) or irreversible (broken pH probe, for example).

In general, all data resulting from a known failure of a sensor within a particular deployment should be rejected. However, an exception to this general rule may apply in some turbidity studies as discussed below. A listing of possible failure mechanisms for each sensor is provided below. In some cases a figure documenting a data discontinuity, which appears to be associated with the failure mechanism, is also provided.

Time

On occasion, time jumps (from seconds to minutes) can occur in the datasonde file for no apparent reason. There are two explanations for this. First, the datasonde could have been interrupted by an uploading session while the sensors were trying to record water quality data or the contacts between the batteries and the datasonde (the metal coil) may have gotten damp and needed cleaning.

It is important to document in the metadata when the time was off. Times will be corrected to the nearest quarter hour during primary QAQC.

Time Gaps in the data file & Internal Device Error statement

If time gaps are observed in the uploaded data file or if a time gap is suspected, then you may have an Internal Device Error problem with the datasonde. This is an indication of a handshaking problem between the internal boards of the instrument. When the board that runs the sensors transfers the sensors' signal to another internal board, there occasionally can be a communication problem. When a communication problem does occur, an Internal Device Error statement appears and there is a statement on a time line that the error has occurred INSTEAD of the data. Thus, when an Internal Device Error occurs there are no data at all at for that particular time. The message indicates that a sample is missing. It does not mean that the data before or after the error message is bad. In the file report, the only evidence of an internal device error is a time gap in the data.

Note: An internal device error statement is only visible in the "viewed data" and not in an "uploaded data" PC6000 formatted file. View the data on the screen using the View command from the datasonde and look for the internal device error log.

Any data that are recorded in the memory is probably okay since internal device errors do not affect sensor performance, only internal communication. Contact YSI to determine how to recover the data.

Temperature

The temperature sensor on the YSI 6560 probe rarely fails. If it does fail, the malfunction is inevitably irreversible and due to leakage of environmental water into the thermistor container. Although we have only very limited experience, the failure of the temperature sensor is usually signaled by jumpy and/or clearly incorrect readings. If a problem is suspected, the accuracy of the thermistor can be checked on return vs. another Model 6600 or a mercury-in-glass thermometer.

If a clear point of temperature discontinuity is present in a data record, all temperature readings from that point on should be eliminated from the official SWMP datasonde data record. This point might be signaled by a sharp jump in temperature to an unexpected value or an overall drift that seems unreasonable.

Since the data from all other sensors (salinity, specific conductivity, depth, dissolved oxygen mg/L and % sat, pH, turbidity and chlorophyll-a) are temperature compensated using the values from the thermistor, all values for all logged parameters after a temperature probe failure should be rejected from the official record. Thus, because of the ubiquity of temperature compensation, failure of the temperature sensor is particularly serious for the overall data record. This is demonstrated in Figure 3 where the temperature sensor failed during the study. However, remember that temperature probe failure is extremely rare.

Conductivity

The conductivity sensor of the YSI 6560 probe seldom shows catastrophic failure. If an error occurs, the symptom is usually a drift of the overall conductivity output due to a changing of the cell constant during deployment. This cell constant change is, in turn, usually due to the presence of fouling in the cell compartment that causes a change in the effective volume. If the perturbation only involves the coating of the cell and electrodes with a layer of fouling, the change in cell constant is usually not significant. However, the formation of barnacles in the cell constant will result in readings that are in error.

A post deployment check of the sensor in a solution of known conductivity (not necessarily a primary standard) will allow the Research Coordinator to assess the extent of the drift. Cleaning of the sensor as described in the manual almost always reverses the drift caused by significant change in the cell volume. If a reversible drift is suspected, a linear compensation based on quality assurance data (pre-, mid-, and post-

deployment) is possible using PC6000 software. YSI recommends that the decision as to whether to employ this (or any) compensation be left in the hands of the Research Coordinator.

In the unlikely event of a total sensor failure, a sharp discontinuity will usually appear in the output. All affected readings (salinity, specific conductivity, dissolved oxygen mg/L and depth) should be eliminated from the SWMP datasonde database after this type of failure.

Remember though that sharp discontinuities in Conductivity can also be due to the datasonde being out of the water, as is described in the Absolute Data Rejection (2) section above or as a result of a incorrect calibration. The BEST indicator of determining whether a datasonde was out of the water is to use the Conductivity data. (See Figure 1A and 1B). Use the conductivity data in conjunction with depth values to help with decision-making.

If the datasonde was deteremined to be out of the water, reject ALL YSI data in these areas of the data record because it is impossible to tell whether the other sensors were in the water at the time of measurement.

pH

Like the conductivity sensor, the pH probe of the YSI 6600 seldom shows catastrophic failure. If an error does occur, the symptom is usually a drift of the overall pH output due to a perturbation of the reference electrode during deployment. A post deployment check of the sensor in a solution of known pH (usually pH 7 buffer) will allow the Research Coordinator to assess the extent of the drift. The drift is usually confined to the sensor offset, not the sensitivity, and while not reversible *per se*, can normally be "calibrated out" prior to the next deployment. If a reversible drift is suspected, a linear compensation based on quality assurance data (pre-, mid-, and post deployment) is possible. A decision to employ this (or any) compensation should be left in the hands of the Research Coordinator.

In the event of a complete sensor failure (most likely due to breakage of the glass bulb),

(1) a sharp discontinuity may appear in the output,
(2) the readings may either be totally unreasonable,
(3) the ISE1 mV output in the Diagnostics submenu may be exactly 0 mV no matter what solution the sensor is immersed in, and/or
(4) the readings will show a great deal of noise.

The last failure symptom is demonstrated in Figure 4. All readings after this type of failure should be eliminated from the SWMP datasonde database.

A more subtle clue to a near sensor failure (due to probe age or due to the gel drying up) was provided from NOC NERR's experience and indicates that the sensor will read from 5 to 6 units no matter what calibration solution it is in. The probe will not calibrate to any calibration standard. All readings from this type of failure should be eliminated from the SWMP datasonde database. From DEL NERR's experience, another clue to a near sensor failure due to probe age is that the pH sensor appears to be working fine when the probe is submerged in a particular pH standard (for example, if the standard is a pH of 9, the probe's readings will be near 9), and it appears to track changes in pH; but when you try to calibrate the probe, the calibration is not accepted. After soaking the probe to restore it, it may appear to work properly and accept calibration. However, within a few weeks the message "calibration not accepted" may again be generated during calibration.

YSI technical support stated that this problem might also indicate that the internal coefficients for the pH calculations are incorrect (which will be the case for a newly installed pH probe). Corrective action in this case includes clearing the internal coefficient values and recalibrating with a 2-point calibration. Contact YSI for specific procedures to check, clear, and reset the datasonde internal coefficients. Whether or not resetting the

internal coefficients would have rescued the DEL NERR site's failing probe, it is not known. All readings from this type of failure should be examined carefully before being submitted to the NERR SWMP datasonde database.

Dissolved Oxygen

The oxygen sensor of the YSI rapid-pulse 6562 probe is susceptible to both drift and catastrophic failure during deployment. Drift is usually caused by deposition of a layer of biological fouling on the sensor membrane. The puncturing of this membrane by biological fouling usually causes catastrophic failure. A post-deployment check of the sensor in a medium of known DO content (usually water-saturated air or air-saturated water) will allow the Research Coordinator to assess the extent of the drift. If a reversible drift is suspected, a linear compensation based on quality assurance data (pre-, mid-, and/or post deployment) is possible. YSI recommends that the decision as to whether to employ this (or any) compensation be left in the hands of the Research Coordinator.

If the membrane is improperly installed or is punctured during the deployment, the sensor output is generally characterized by a large discontinuity. Figures 5 and 6A-C demonstrate this effect that is suspected to be due to membrane holes. Figure 5 shows DO failure at the beginning of the deployment and could well be due to improper membrane installation. Figures 6A-C shows failures during the deployment that are likely due to a membrane puncture from debris or animal activity. In most cases, the DO readings become unreasonably high very quickly and then drift off to varying extents. In Figure 6C however, the readings simply rise precipitously at the suspected point of puncture and then become noisy. For both symptoms, YSI suspects that the cause of the error is "cross talk" through the membrane hole between the DO and conductivity sensors in the conductive brackish water medium.

In all cases, all percent saturation and dissolved oxygen mg/L readings after the discontinuity should be eliminated from the SWMP datasonde database for that deployment record. Note, however, that sensor malfunctions from membrane punctures usually affect only the DO data of the deployment in question -- reconditioning and re-membraning the probe correctly prior to the next deployment will likely return the sensor to its proper operating condition.

The dissolved oxygen sensor can occasionally fail during a deployment due to electrochemical or materials failure (fouling of the anode, internal short in the probe, etc.). These problems are usually characterized by a discontinuity in the data record and can usually be confirmed by the presence of high DO charge and/or noisy or negative readings during the post deployment check of the DO sensor. As for membrane punctures, the sensor is not likely to recover function during a deployment once these events have occurred and therefore, all DO readings associated with this deployment after the discontinuity should probably be eliminated. Some of the latter symptoms (internal shorts, material breakdown from age) are irreversible and will require probe replacement. For fouling of the electrodes, however, probe function can usually be restored by reconditioning the probe face with the fine sandpaper found in the 6562 kit.

The 6150 ROX optical dissolved oxygen probe contains a sensor that is completely different than the rapid-pulse type DO sensor. It features a more durable membrane that is less likely to experience catastrophic failure and a cleaning system to decrease fouling and sensor drift issues. The ROX DO sensor is still relatively new, and it remains to be seen what the key difficulties with this sensor might be. In general, however, if a catastrophic failure occurs, all subsequent readings must be rejected. Any other data anomalies should be rejected or marked as suspect and documented at the Research Coordinator's discretion.

Depth[18]

The shallow depth sensor is a non-vented probe that is very susceptible to changes in barometric pressure. Negative depth values are a possibility when the sondes are deployed in shallow estuaries, as shown in Figure 7. Do not reject the depth values or the data for the other probes based on **negative** depth readings alone. Examine the other probe's readings (primarily specific conductivity) to determine whether or not the datasonde was actually out of the water. (See the information about how the specific conductivity can be used as an indicator of the instrument being out of the water).

Make sure that the probe was out of the water before rejecting and deleting the negative depth and other sensor values. If the depth probe was out of the water, the depth reading(s) will be negative and the other probe reading(s) (especially specific conductivity and salinity) will also be bad (Figure 1A and 1B). Reject all data after it has been determined that the datasonde was out of the water.

If the depth probe was not out of the water and the depth readings are negative, the other probe readings will be in line with the previous data (Figure 7). Do not reject the data but mark the negative depth data as anomalous and document it in the metadata.

From discussions with YSI's John McDonald (January 1997), it was determined that with the non-vented level probe, measurements could be as much as 0.39m (1.3 feet) off with an intense low pressure hurricane event. Keep this in mind when evaluating these data.

Note: The NERRQAQC macro will still flag negative depth values (anything < zero), but this is done purposely to warn you that the data may be erroneous and that the data need to be examined and evaluated.

Turbidity

The 6136 turbidity sensor associated with the YSI 6600 is usually not susceptible to drift *per se*. This means that there will generally be little need for manual compensation of readings during a deployment due to the fouling or sensor drift that may affect the conductivity, pH, and dissolved oxygen sensors. The turbidity sensor can, however, produce erroneous readings for reasons other than drift such as mechanical failures. Examples of these are leakage of water into the sensor housing and scratches on the optics caused by an improperly installed wiper. The sensor can fail completely during deployment as shown in Figure 8 where the flat readings are almost certainly due to complete loss of probe sensitivity. Clearly, turbidity readings after this type of discontinuity should be rejected (Figure 8).

High Positive Turbidity Spkes (may be >1000)

Sometimes turbidity readings can be erroneously high; either within the normal range of the instrument (0 to 1000 NTU), or outside of its normal range (>1000 NTU). The most common problems associated with erroneous, high turbidity values are the following:

(1) the presence of a large quantity of debris such as algae or *Spartina*,
(2) animals in the probe compartment,
(3) the wiper parking over the optics, or
(4) when there are actual turbidity values that the sensor is experiencing that are very high or > 1000 NTU (greater than the range the probe can measure). This is a real event that the probe is experiencing and is not an error. Figure 9 shows that after a failure of a water control structure (see water level values before 14/07/96 0:00) which released a huge volume of water into the

[18] Even though the depth probe is not supposed to measure below zero, it was agreed at the NERRS meeting at St. Simons Island, GA (November 1996) that negative depth would be allowed (and categorized as anomalous) due to the way the sensor could be influenced by low pressure weather systems.

system that Delaware NERR was measuring, turbidity was increased beyond 1000 NTU. This event also caused the turbidity sensor to "roll over"[19].

In 1-3 above, the sensor is affected by a direct interference from a foreign body or the wiper. Sometimes the wiper can be jammed over the optics by debris or the wiper will park over the optics due to a dirty wiper blade. Note, in some cases you will need to replace the wiper and recalibrate the probe. All scenarios listed above can cause very high readings.

The turbidity probe is an optical probe, which causes it to behave very differently that the rest of the probes. However, as opposed to the other sensors, if there is a malfunction it can be completely reversed within a given deployment. Thus, if the impediment is removed from the optics via natural causes in subsequent readings, there is no reason to suspect their validity.

If it is determined that there was an animal living in the YSI instrument, or debris was seen attached to the wiper area, or the wiper was stuck in the middle of the turbidity window, then reject the data. This is where deployment notes are important to note any unusual circumstances regarding the instrument deployment. Make sure to review the turbidity data from each deployment and make a judgment as to the possible reliability of the data if large spikes occur and whether this data should be included in the SWMP datasonde database.

However, since occasional high positive spikes that are not consistent with the overall data record may be real (Figure 12) and, in most cases, it cannot be determined whether or not the anomalous value is due to animal, debris, wiper, or natural causes, it is recommended that these data be considered suspect and documented as such in the data. Turbidity spikes should be rejected at the Reserve's discretion and only if you are sure that they are erroneous.

Tip: Small meshed netting over the sensor guard secured with cable tires can protect the probes from debris and animals taking up residence in the probe area. Contact YSI for the suggested mesh size and type.

Small Negative Values

Just a small amount of water left on the probes (from the cup that the probes are stored in) can contaminate the zero turbidity standard when calibrating the turbidity probe. Contamination can cause the zero calibration to be off by +5 to +8 NTUs. So when the probe really experiences zero turbidity, the values are -5 to -8 NTU. Therefore, shake or dry off the instrument and probes thoroughly before continuing with calibration.

Due to this possibility, small negative turbidity values should be flagged as suspect even if within acceptable calibration/accuracy error and documented as such.

[19] Before the release of Version 3.10 datasonde software for the YSI 6000UPG in January 1997, there was a "rollover" problem with the turbidity probe. When the A/D converter of the turbidity probe senses a very high reading, it "rolls over" and the output of the system becomes large and then negative. Thus, wiper malfunctions, direct interference in the optics, or turbidity values >1000 during a reading are usually characterized by very large, negative NTU data points as shown in Figures 10 and 11. The distribution of new datasonde software (Version 3.10 and higher) from YSI corrected this problem.

FIGURE 1A

Sonde suspected to be out of water periodically during study. Reject all WQ data during periods of low conductivity.

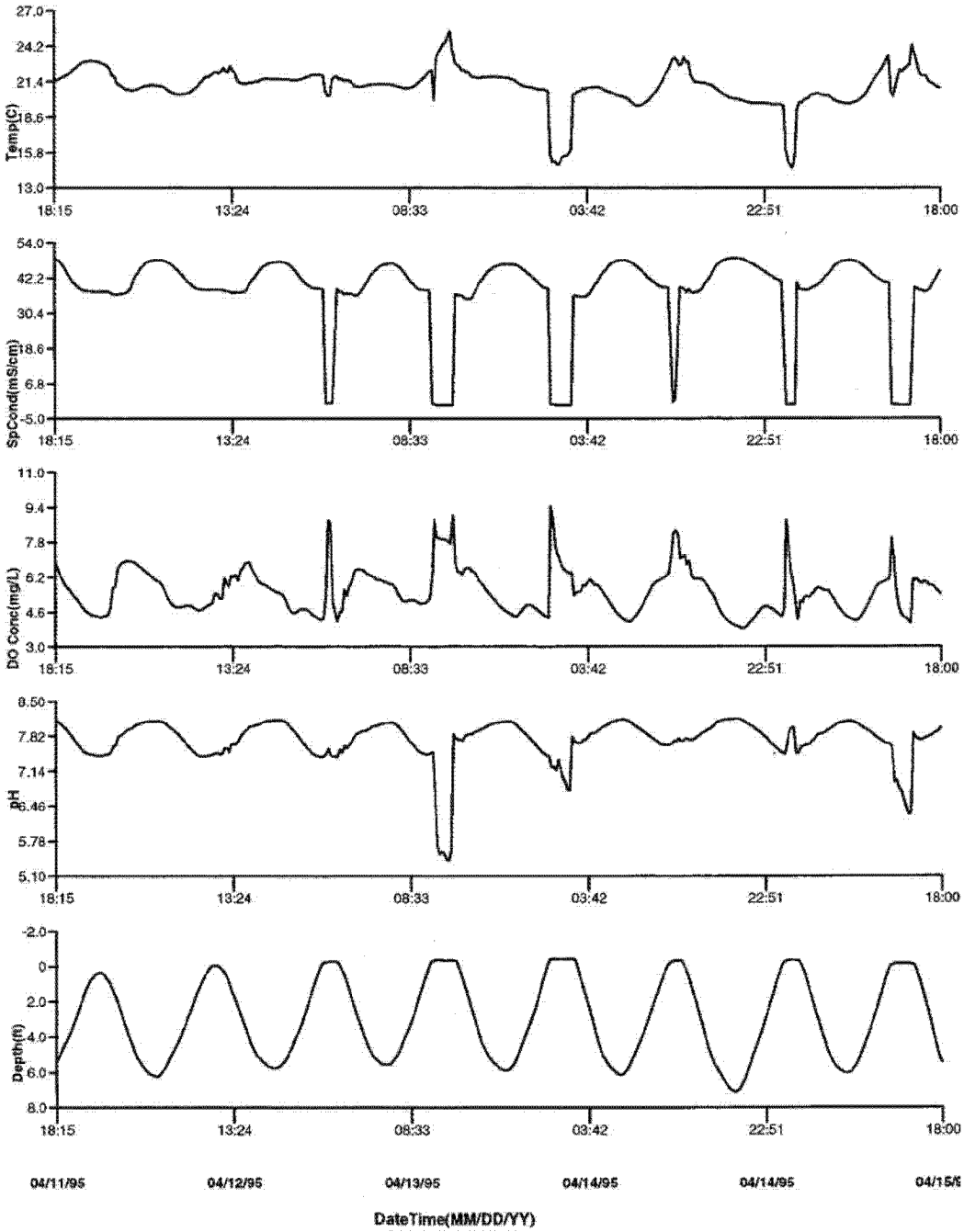


FIGURE 1B

Sonde suspected to be out of water during last 1/3 of study. Reject all WQ data after discontinuity.

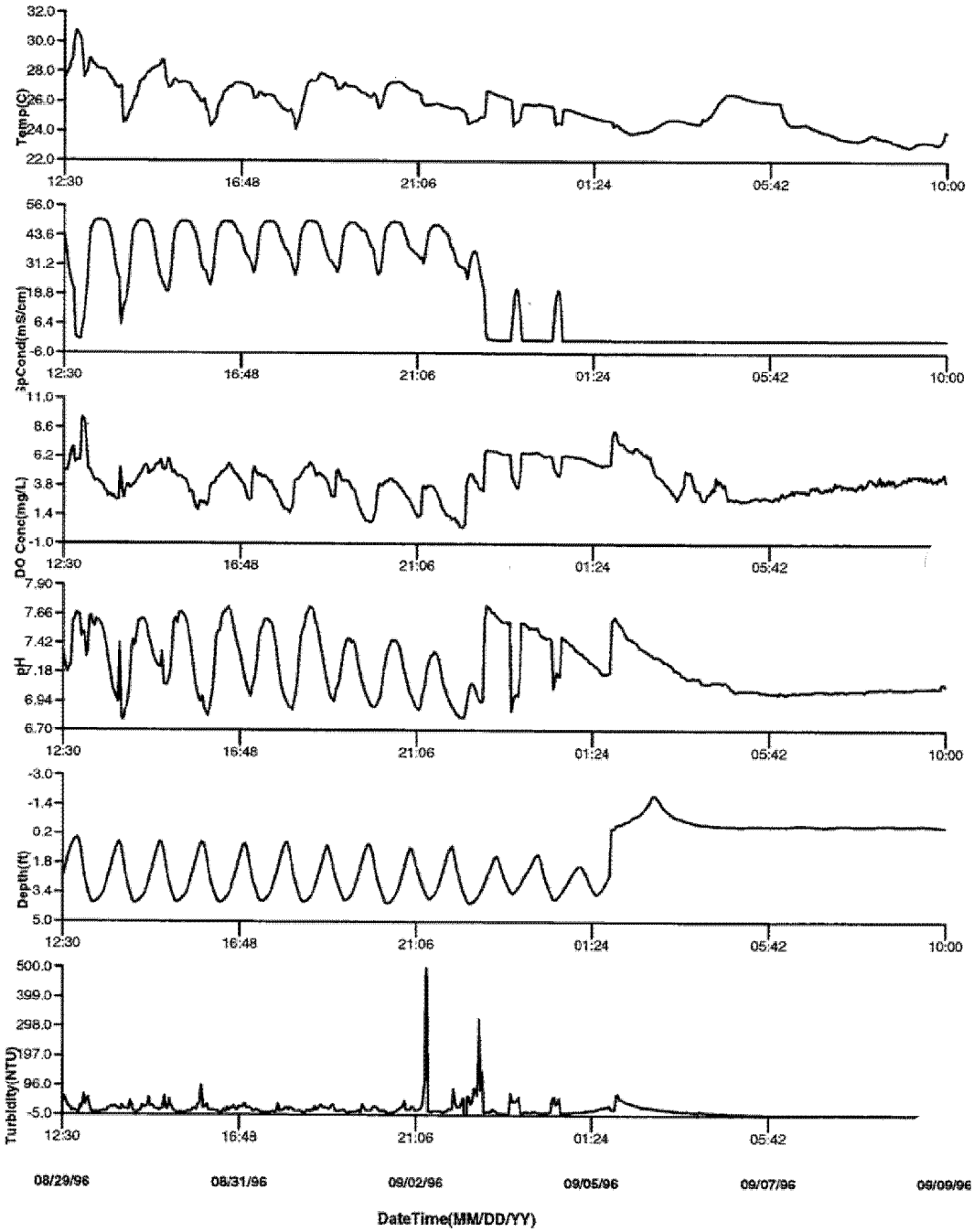


FIGURE 2

Reject and delete both the beginning and end ("tails") of the data record

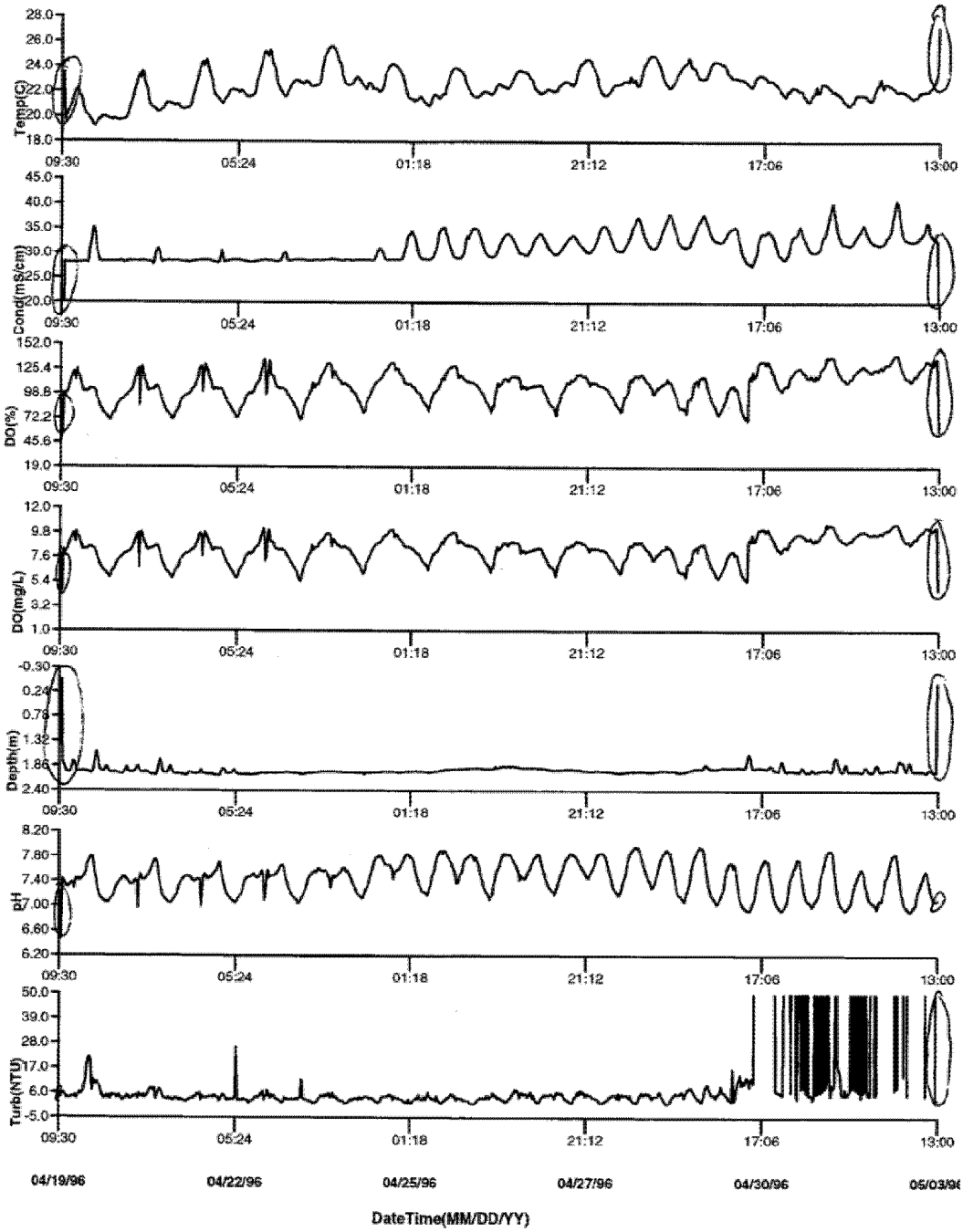


FIGURE 4

Malfunctioning pH probe evident from noise. Reject all pH data.

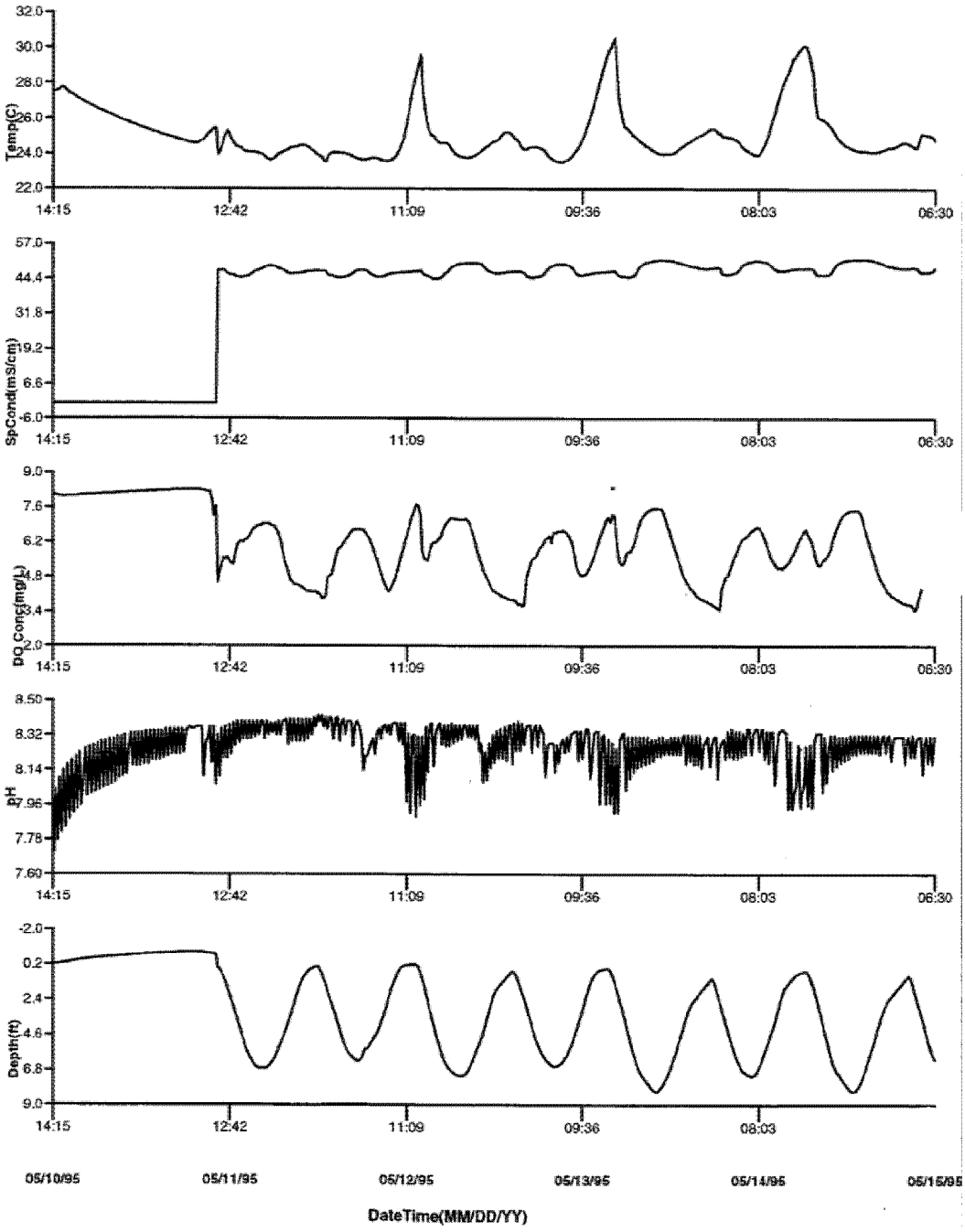


FIGURE 5

Immediate problem with DO membrane integrity. Suspect improperly installed membrane. Reject all DO data.

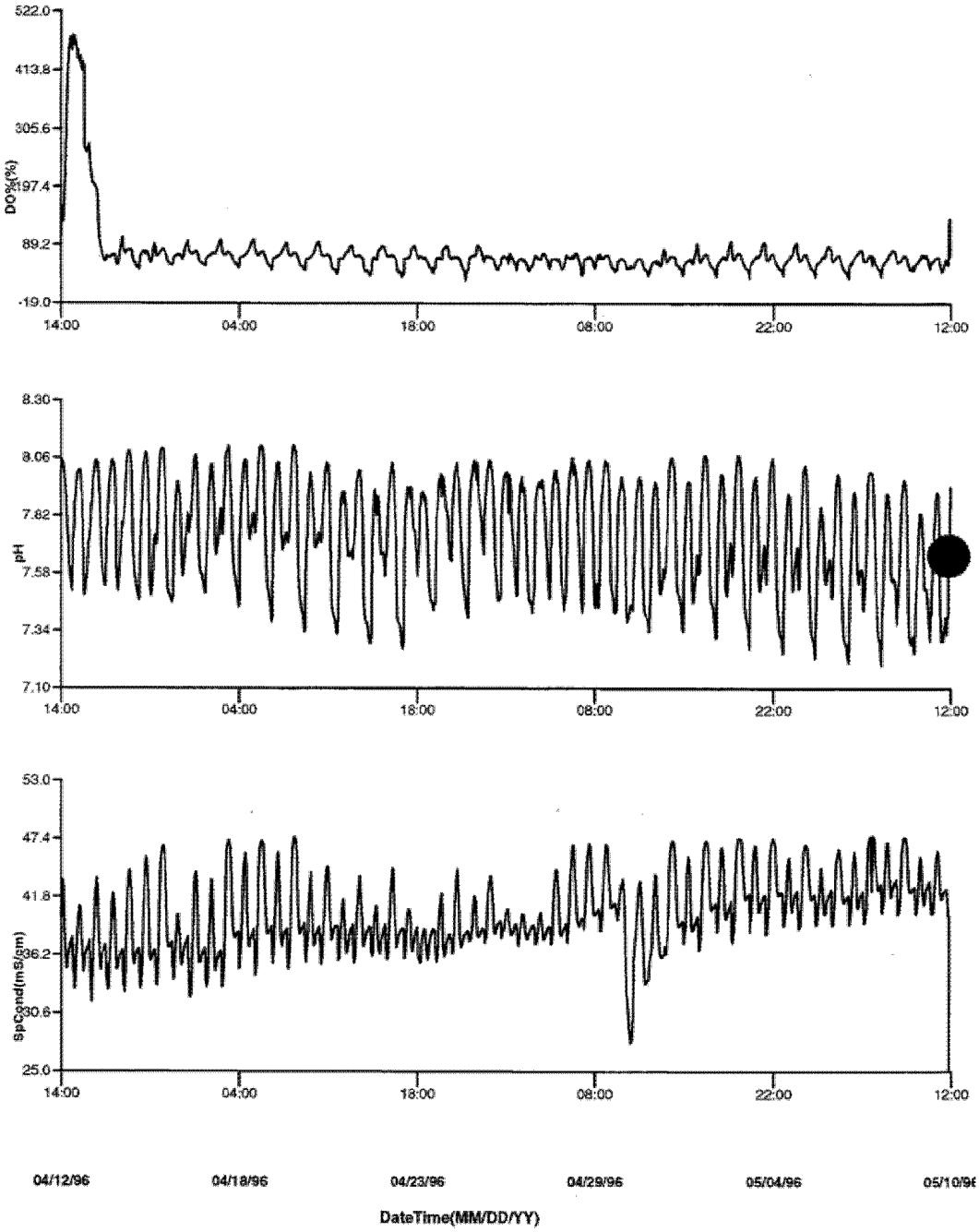


FIGURE 6A

Suspected DO membrane pucture late in study. Reject all DO readings after discontinuity.

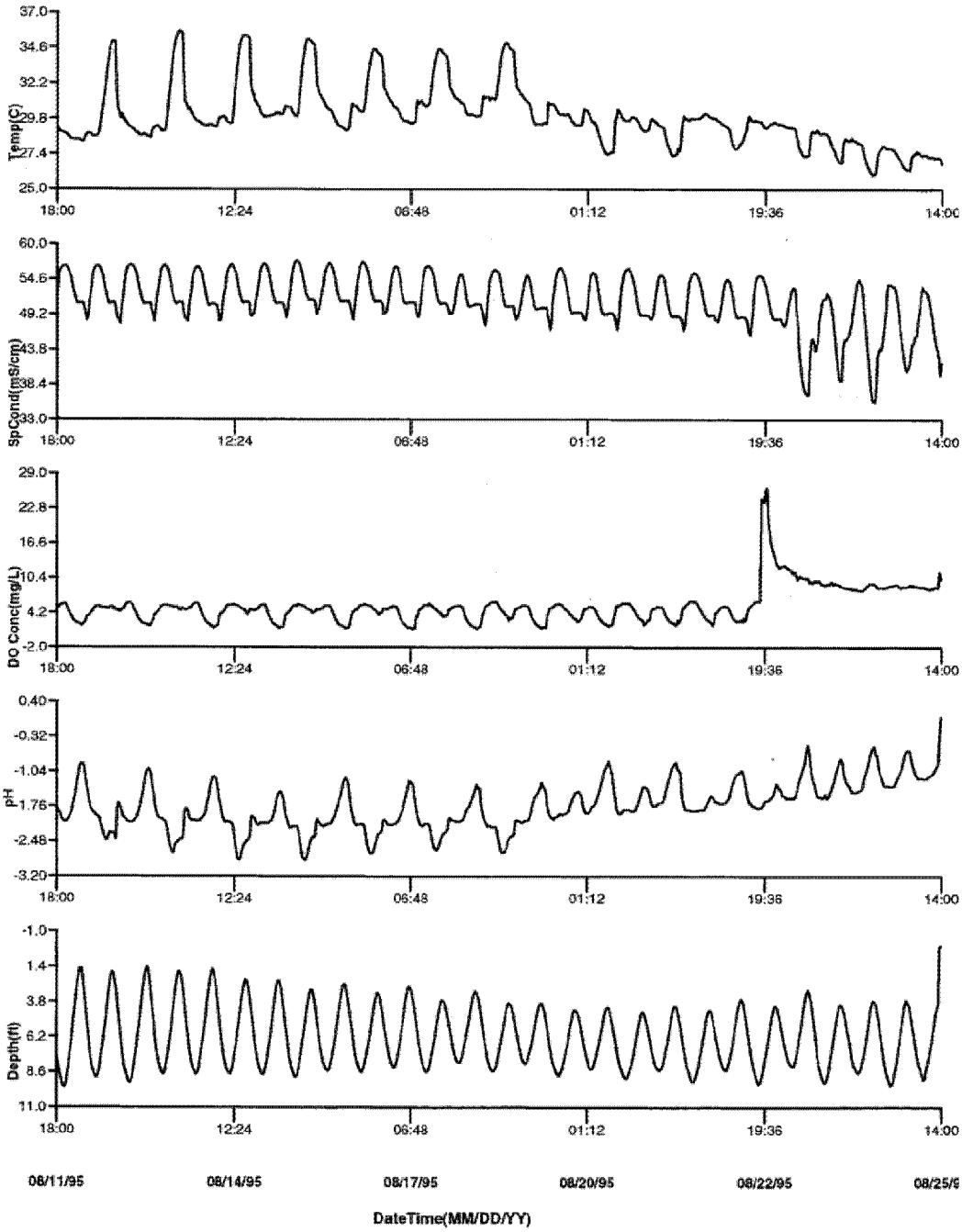


FIGURE 6B

Suspected DO membrane puncture early in study. Reject all DO data after discontinuity.

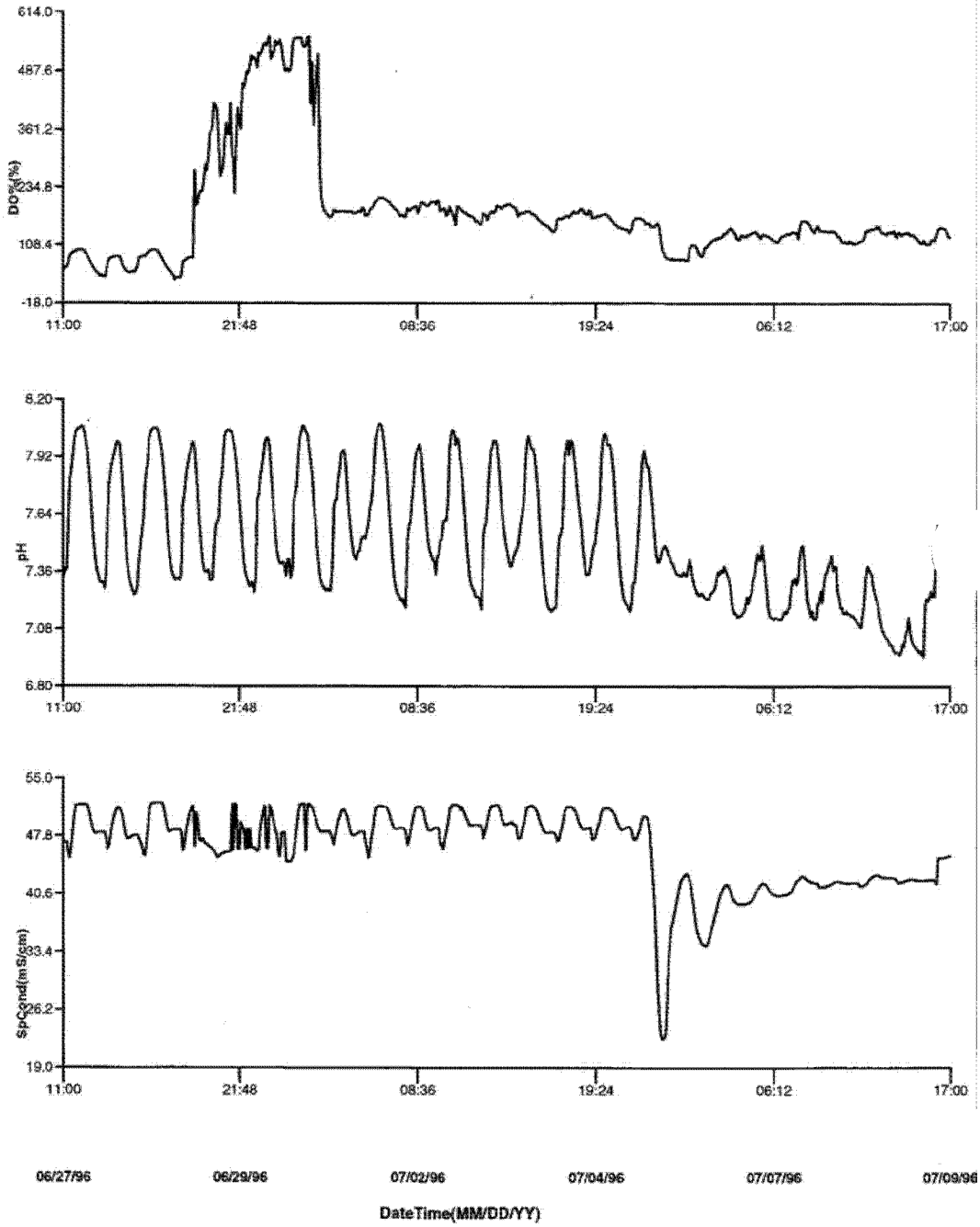


FIGURE 6C

Suspected DO membrane puncture 1/3 through study. Reject all DO data after discontinuity.

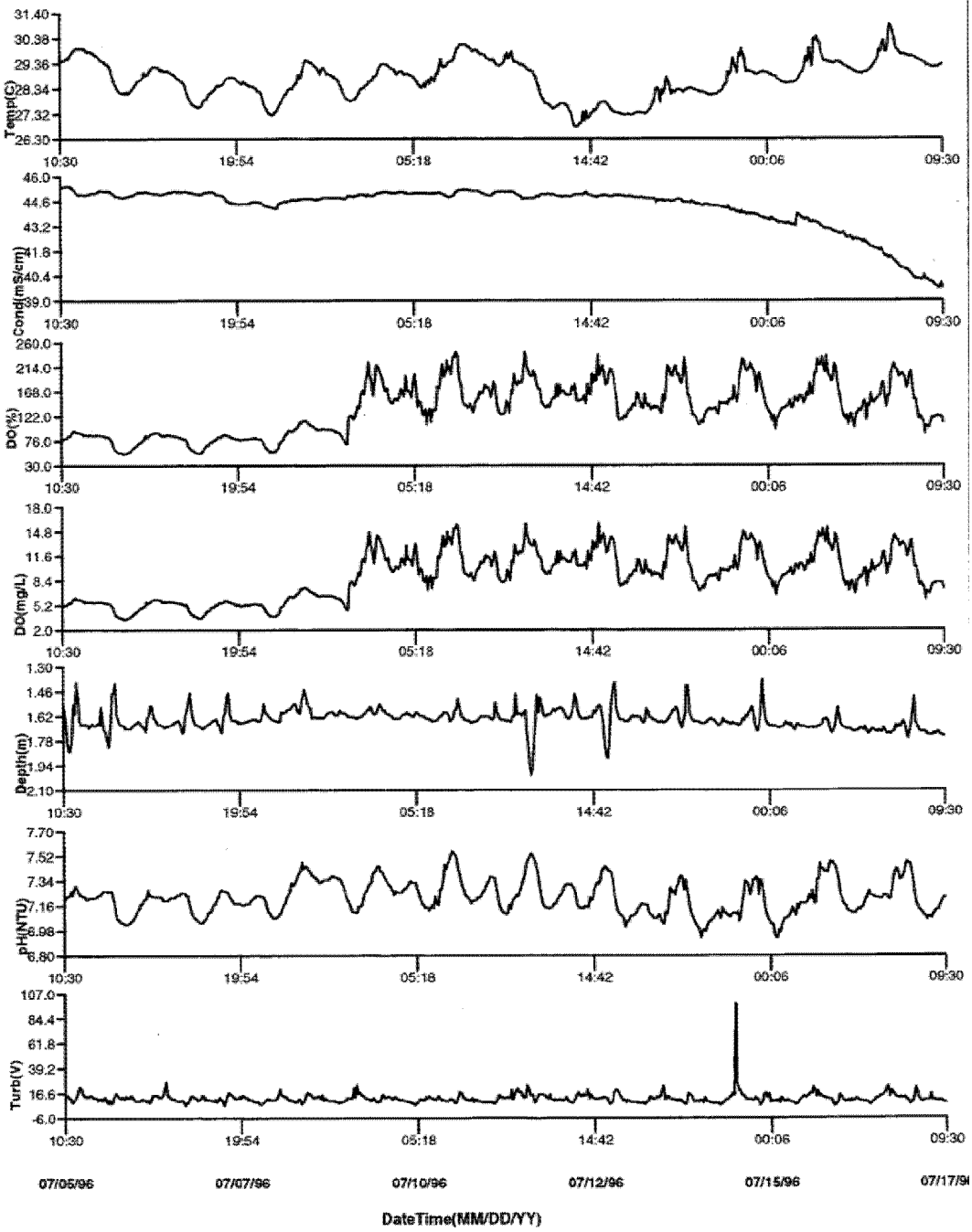


FIGURE 7

Do not reject negative depth when the other values are determined to be correct

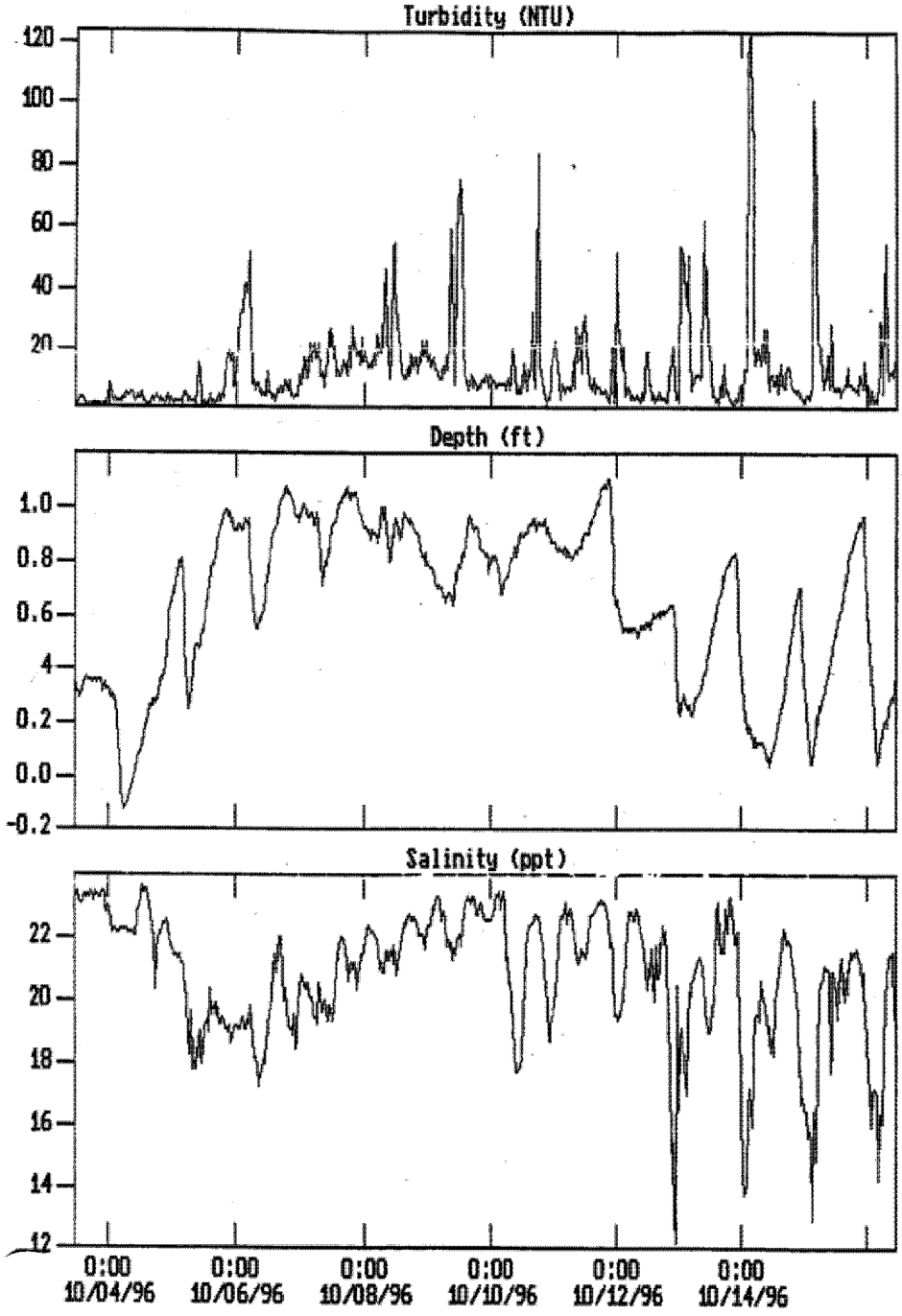


FIGURE 8

Turbidity probe failure during deployment. Reject all readings after failure.

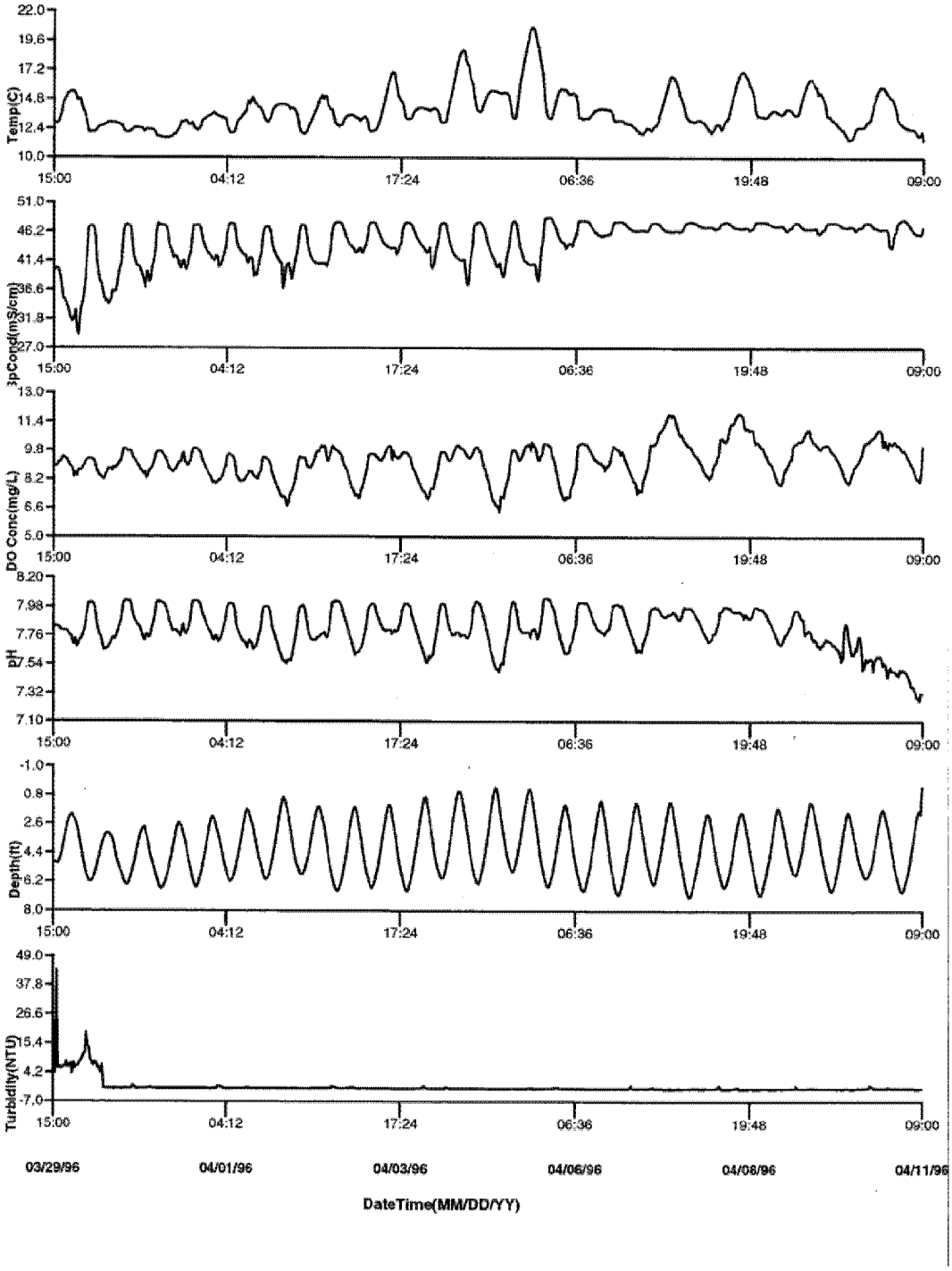


FIGURE 9

Do not reject high and large negative turbidity values when turbidity values > 1000

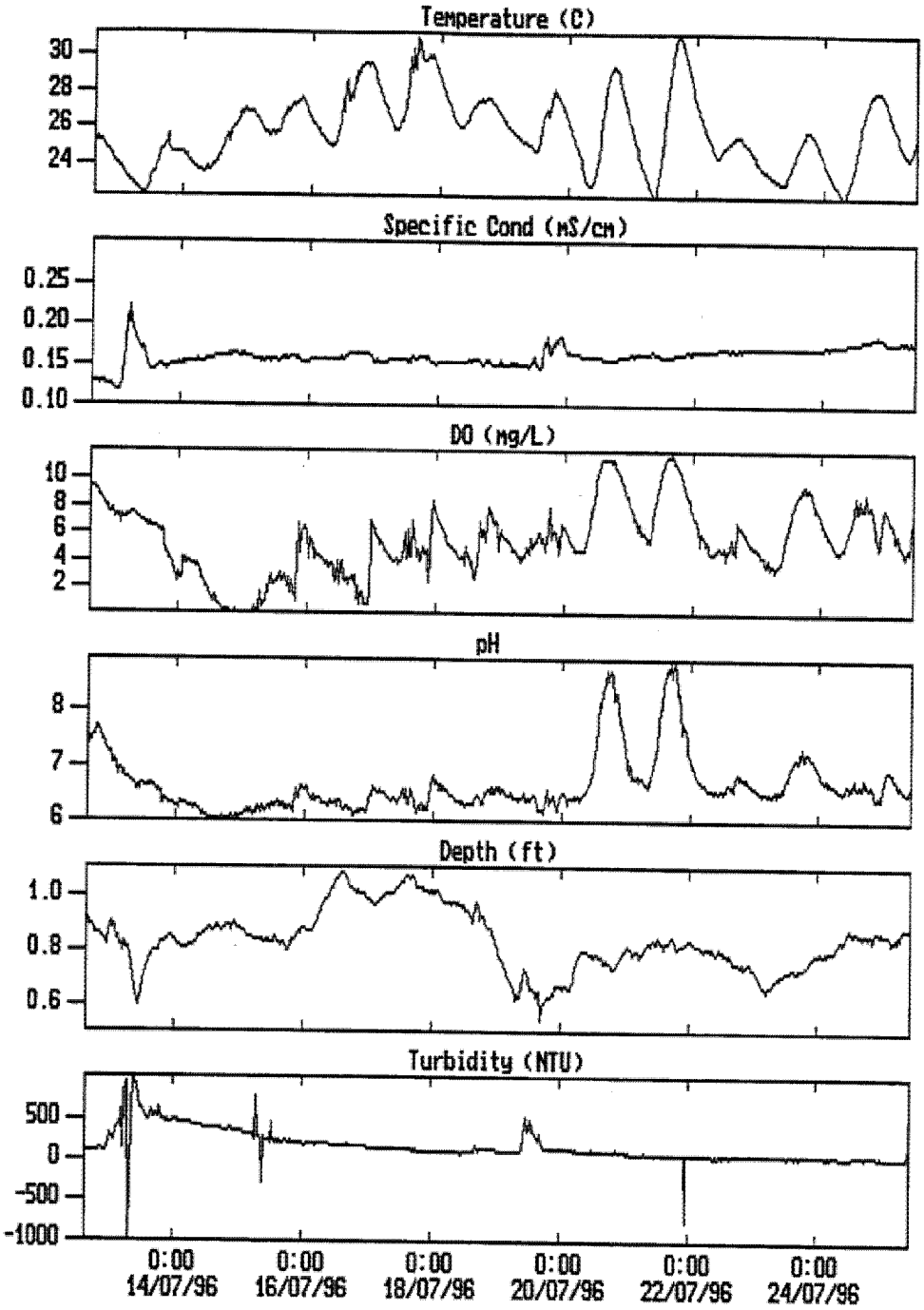


FIGURE 10

Reject and accept turbidity readings at site coordinator's discretion

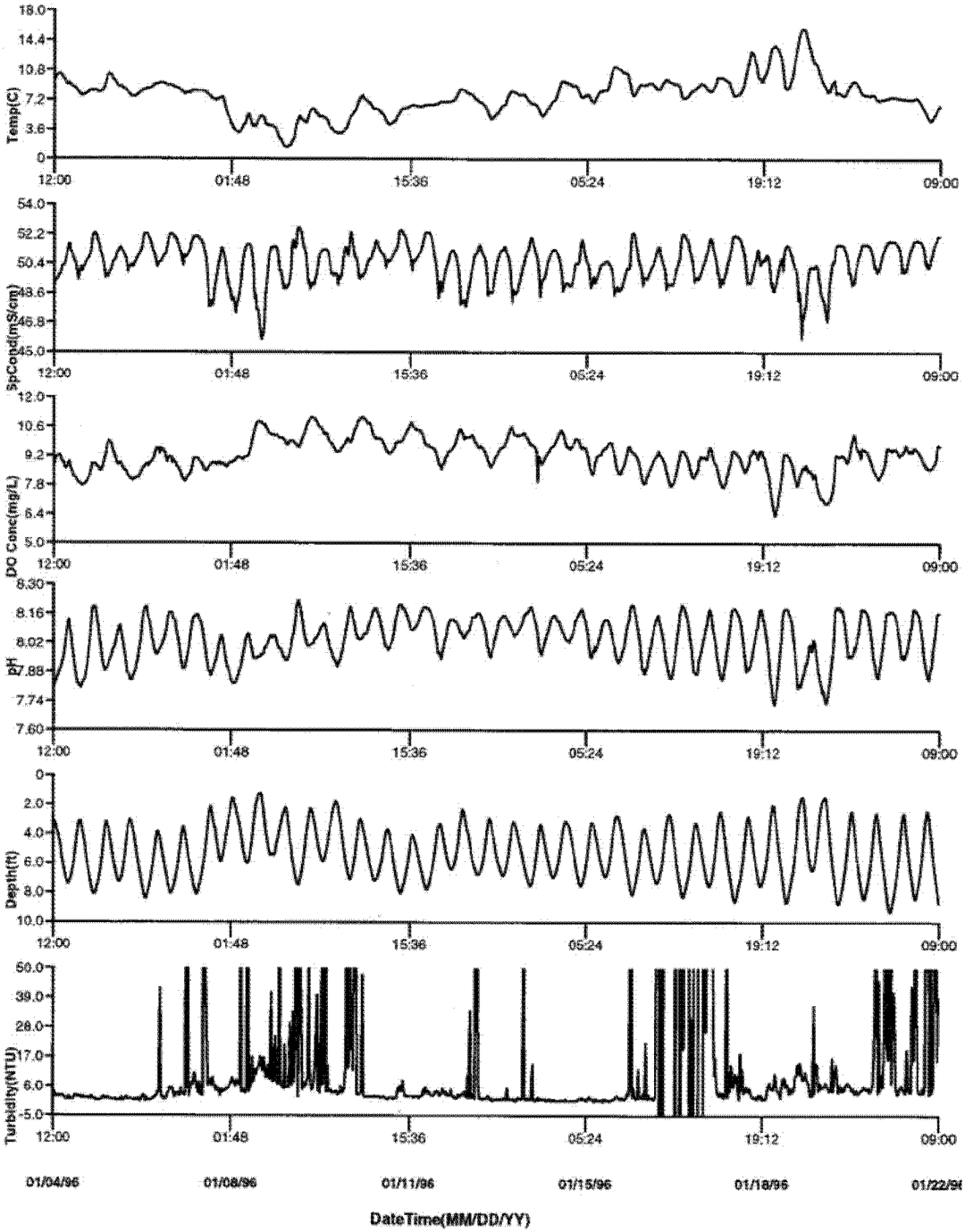


FIGURE 11

Reject or accept large negative turbidity values at site's discretion

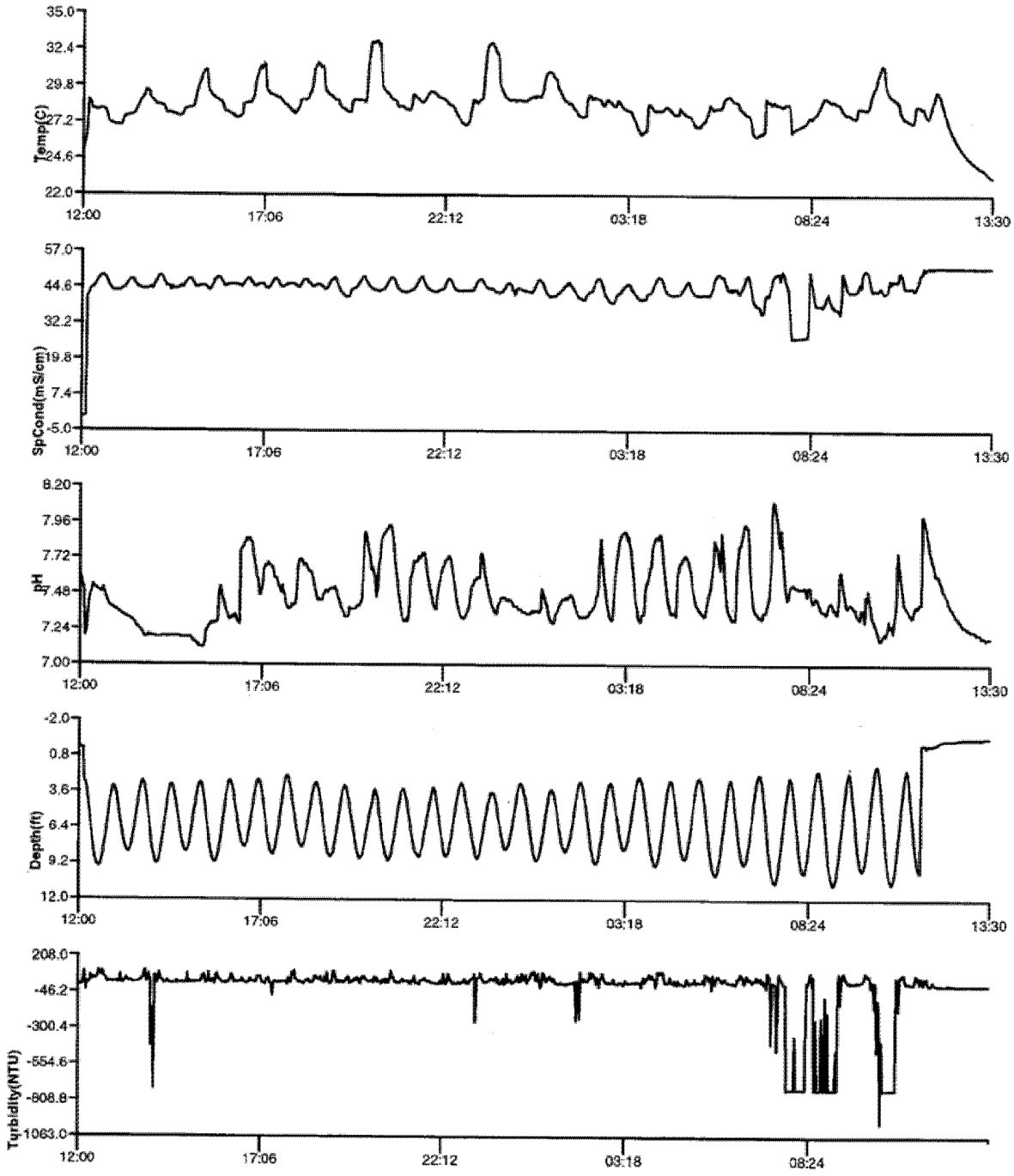
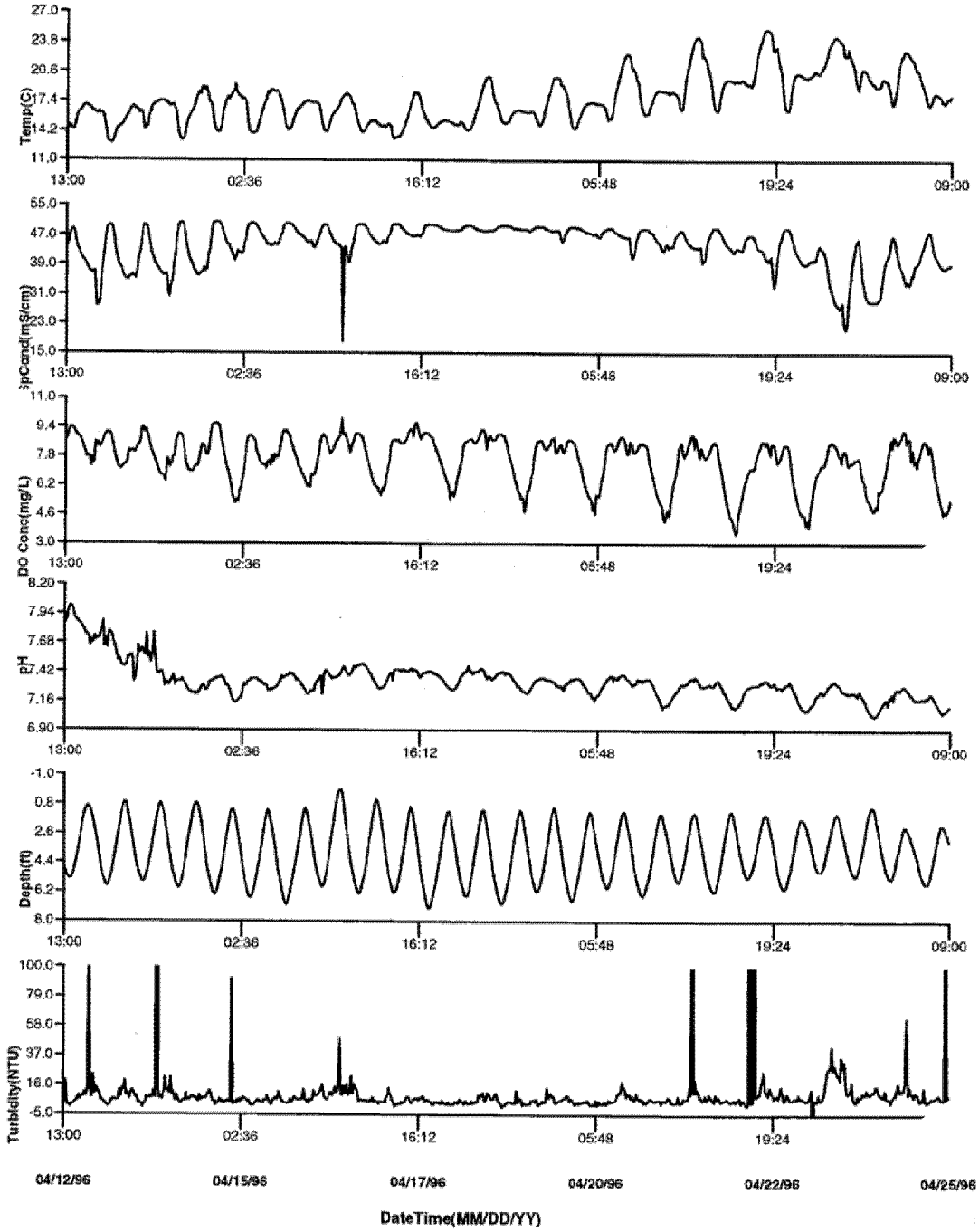
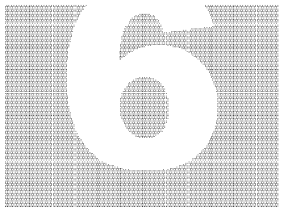


FIGURE 12

Reject or accept large negative turbidity values at site's discretion

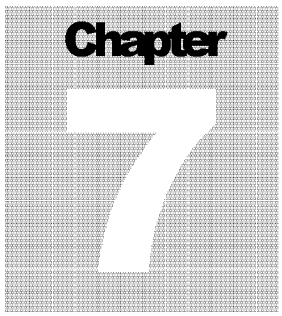


Chapter



Standard Operating Procedures: Meteorological Monitoring

(INSERT CAMPBELL SCIENTIFIC CR1000 BASED METEOROLOGICAL SOP HERE)



Meteorological Data Management Procedures

The Meteorological Data Management Procedures chapter describes the collection, review, error checking, editing, graphing and export of the data as well as the creation of the associated metadata.

Data submission timelines

Raw data files must be submitted to CDMO for automated primary QAQC and provisionary posting within one week of data retrieval from the CR1000.

Primary QAQC'd files must go through secondary QAQC at the Reserve and be submitted to CDMO on a quarterly basis. These files will be posted as provisional plus data.

Primary QAQC data collected during months:	Must go through secondary QAQC and be submitted to the CDMO by:
January - March	May 1st
April - June	August 1st
July - September	November 1st
October - December	February 1st

Table 4. Secondary QAQC submission

Yearly secondary QAQC'd files must be submitted to CDMO for final review by April 15 of the following year. Reserves will append their quarterly data submissions into yearly data files, which will replace the quarterly files on the CDMO ODIS and again be posted as provisional plus data. In addition, the yearly metadata file and monthly log sheets are required for final submission. After the CDMO performs the final tertiary QAQC, the data will be posted as authoritative.

IMPORTANT: Notify the CDMO of your quarterly and yearly secondary QAQC'd data submissions. This will enable us to verify that your submission is complete *before* the deadline.

Overview of data collection

The meteorological monitoring program began in July 2001. All meteorological data should be collected in 15-minute intervals. The Campbell Scientific meteorological station should be set up to collect the following required parameters in the following order with additional sensors included at the end of the file.

Parameter	Short Name	Units	Format
(1) DateTimeStamp	DateTimeStamp	m/d/yyyy h:mm	
(2) Record	Record		
(3) Average Air Temperature	ATemp	°C	00.0
(4) Average Relative Humidity	RH	%	000
(5) Average Barometric Pressure	BP	mb	0000
(6) Average Wind Speed	WSpd	m/s	00.0
(7) Average Wind Direction	Wdir	°	000
(8) Maximum Wind Speed	MaxWspd	m/s	00.0
(9) Maximum Wind Speed Time	MaxWspdT	hh:mm	hh:mm
(10) Wind Direction Standard Deviation	SDWDir	sd	000
(11) Total Precipitation	TotPrcp	mm	00.0
(12) Total PAR (LiCor)[20]	TotPAR	mmoles/m^2	0000.0
(13) Average Battery Voltage	AvgVolt	volts	00.0
(14) Cumulative Precipitation	CumPrcp	mm	00.0
Optional Parameter:			
(15) Total Solar Radiation*	TotSoRad	watts/m^2	0000

*Total Solar Radiation is an optional SWMP supported parameter. It is not required; but may be submitted to the CDMO and posted on the CDMO ODIS. If a Reserve does choose to submit an optional SWMP supported parameter, it must go through all SWMP QAQC and data management procedures.

[20] PAR refers to photosynthetically active radiation and is recorded in millimoles/meter ^ 2.

Meteorological data review and editing tips

1) **Always archive the data**. Keep copies of your data on other computers, on CD and on other hard drives. Backup and archive on a regular basis to ensure there will be no data loss. Third party software can be purchased to accomplish this. Archive the **raw .DAT files** from the CR1000 as they are retrieved.

2) **Always record in Standard Time NOT Daylight Savings Time**. Set the clocks on your CR1000 and the computers that interface with them to Standard Time and DO NOT adjust them to Daylight Savings EVER. Try to get in the habit of recording the time off your watch in Standard Time as well.

3) **Regarding program reloads**: After a program reload occurs, the 5-second data being held in the temporary storage location of the CR1000 **WILL BE LOST** resulting in inaccurate 15 averages, maximums and minimums, and totals for the particular quarter hour (15 minute interval) the reload or power down occurred. These data will need to be flagged as <-3> rejected data

For example, if a program reload occurs on November 11 at 1115am and the station is turned back on at 1125am, the 1130am data will need to be flagged with <-3> to indicate it should be rejected.

IMPORTANT: Always download the data prior to a program reload.

4) **Regarding station power downs:** When the CR1000 station is powered down, the memory is not purged, however it is still good practice to download the data **BEFORE** powering down the station to ensure no data are lost. Also, the longer the station is powered down, the more skewed and inaccurate your 15 minute average, maximum and minimum data will be since they are computed from readings taken by the station every 5 seconds. These data will need to be flagged as <-3> rejected or <1> suspect.

IMPORTANT: It is highly recommended to download the data prior to a station power down.

5) **No data values are to be removed from the dataset under any conditions.**

6) **You do not need to delete any non-standard parameters in your dataset prior to after conducting secondary QAQC**.

7) When a sensor error occurs, some sensors will output **NAN** (not a number), such as the temperature/RH sensor. These data will be flagged as <-4> during primary QAQC. These outputs should be rejected and coded appropriately.

8) Be aware that the wind direction sensor will output a slightly negative number when wind direction is in the 5-degree deadband zone (355-0 degrees). The resulting value can be interpreted as 0 degrees and changed in the data as such. Remember to document this in the metadata and flag as corrected <5>.

9) **If the temperature sensor fails, relative humidity data will be affected and also need to be rejected.**

10) Sensor malfunctions are evident when plotting multiple files that have been appended together, i.e. monthly, seasonal and yearly files.

Meteorological data management: overview

The management of meteorological data consists of the following components:

(1) **Data acquisition** and visual inspection of the data in LoggerNet

(2) **Primary QAQC** occurs upon submission of the raw file to the CDMO data submission webpage

   a. Data are posted as provisional on the CDMO ODIS.
   b. Data are emailed back to the Reserve with QAQC flags embedded

(3) **Secondary QAQC** of the primary QAQC'd data files and compiled quarterly files with the **NERRQAQC** Excel macro, developed by the CDMO to:
   a. Insert the station code into the dataset
   b. Insert missing records where the CR1000 did not collect data
   c. Format the data according to the specifications in the overview of data collection section
   d. Allow the user to view trends in the data with graphing tools and summary statistics
   e. Facilitate the review of data flagged during primary QAQC
   f. Allow the user to further document the data by applying QAQC flags and codes
   g. Allow the user to append data files to compile quarterly and yearly files for submission and view trends over multiple deployments
   h. Allow the user to export the data in comma delimited format to the CDMO

(4) **Quarterly data submission** to the CDMO
   a. Data are posted as provisional plus on the CDMO ODIS

(5) **Secondary QAQC** of the compiled yearly file with the NERRQAQC Excel macro

(6) **Metadata documentation** to accompany the dataset

(7) **Annual data submission** to the CDMO for tertiary QAQC

   a. Yearly data file, metadata file, and monthly logs.
   b. The yearly data file is posted as provisional plus on the CDMO ODIS, replacing the submitted quarterly data
   c. Data are posted as authoritative after tertiary QAQC and authentication by the CDMO

(8) **Data archival** onto CD, DVD, a separate computer or hard drive, or to the local network and archival of data into EQWin (optional)

Each component will be discussed in this chapter.

Note: The near real time NERRS SWMP data that are transmitted to the CDMO also go through automated primary data QAQC and are immediately made available as provisional data on the CDMO ODIS. Occasionally some of the data received are missing or erroneous due to satellite transmission errors[21] when correct data were recorded and exist in the instrument itself. **This is why it is required that Reserves download the raw files monthly from the telemetered stations for submission to the CDMO**. The near real time data are then replaced by provisional plus data, and finally authoritative data, as detailed above.

[21] Transmission errors are due to a disconnection between the YSI and transmitter and transmitter calculation errors.

Meteorological data management: data acquisition

Data acquisition with LoggerNet

1) **Downloading the data:** Once the data are ready to be retrieved from the CR1000 they should be downloaded to the lab computer as a **comma delimited format** (**.CSV** or **.DAT**). For more details on downloading the data from the CR1000, refer to the Campbell Scientific CR1000 Meteorological Monitoring Station Standard Operating Procedure Version 3.0.

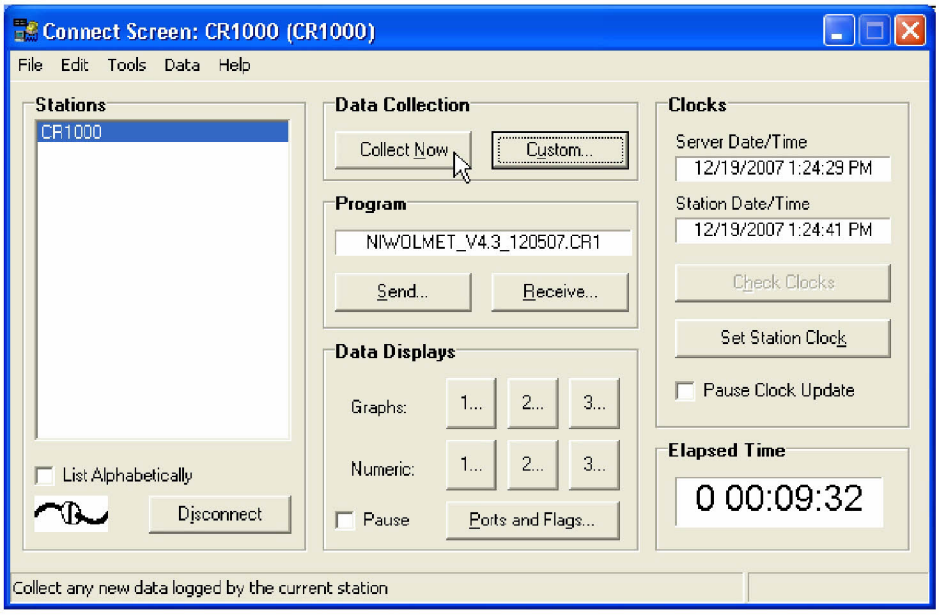


Figure 61. Loggernet Connect Screen.

2) **Inspecting the data:** Once the data are retrieved, it is possible to use LoggerNet to view and visually check the file, noting any obvious errors or problems.

IMPORTANT: The new data management process allows Reserves to submit raw files that contain non-SWMP required parameters. Those data will be ignored by the primary QAQC flagging system but remain in the file to allow for more thorough secondary QAQC.

3) Rename the exported file to follow the required CDMO naming convention using the 3 letter Reserve code, 2 letter sampling site code, data type code (met), and file start data in MMDDYY format.

4) Now the file is ready to be uploaded to the CDMO for primary QAQC. **Raw data files must be submitted to CDMO for automated primary QAQC and provisionary posting <u>within one week of data retrieval</u> from the instrument.**

Meteorological data management: primary QAQC

Primary QAQC flags

There are eleven QAQC flags ranging from -5 to 5. Initial QAQC flags are applied during primary automated QAQC after a reserve uploads raw data to the CDMO. During primary QAQC, data are flagged if they are out of sensor range or missing. All remaining data are flagged as having passed initial QAQC checks. **Note that all data with flags of less than 0 will be masked from the data visualization tools on the CDMO ODIS[22].**

-5 Outside high sensor range: Used during primary QAQC when a value is above the upper limit of the sensor range. Upper limits used for primary QAQC are:

Temp	45 deg
RH	100 %
BP	1060 mb
WSpd	30 m/s
WDir	360 degrees
TotPrcp	25 mm in 15 minutes
TotPAR	5000 mmoles/m^2 for 15 minutes
TotSoRad	1380 watts/m^2 for 15 minutes

Table 5. Upper limits for MET data

-4 Outside low sensor range: Used during primary QAQC when a value is below the lower limit of the sensor range. Lower limits used for primary QAQC are:

Temp	-5 deg
RH	0 %
BP	900 mb
WSpd	0 m/s
WDir	0 degrees
TotPAR	<0 mmol/m^2 for 15 minutes
TotSoRad	0 watts/m^2 for 15 minutes

Table 6. Lower limits for MET data

-2 Missing data: Used during primary and secondary QAQC where a value is missing (not collected).

0 Data passed initial QAQC checks : Used during primary QAQC on all remaining data.

[22] All data regardless of the QAQC flag value are available for export via the CDMO ODIS.

4 **Historical: Pre-automated QAQC:** Used to indicate data that were submitted to the CDMO prior to the use of the automated primary QAQC system. You will only see this flag in data that are exported from the CDMO ODIS and not in your primary QAQC data file.

Raw data submission for primary QAQC

Considerations before submitting to the CDMO:

Ensure that the file exported from LoggerNet contains a header row, otherwise the upload process will be aborted.

Ensure that the file is in **comma delimited format** where commas separate the values). The file extensions available for export from LoggerNet as a comma delimited file include **.DAT**, **.CSV** or **.TXT**.

The **required naming convention for raw data uploaded to the CDMO** is the three letter Reserve code, two letter sampling site code, data type code, and file start date MMDDYY (ex: niwolmet011509). This will enable the CDMO to verify that data are uploaded to the appropriate Reserve, station, and date type tables, thereby reducing upload errors.

Follow the instructions below for the submission of your raw MET data to the CDMO:

1) **Log into the CDMO data upload webpage using your Reserve username and password at http://cdmo.baruch.sc.edu/DataUpload/index.cfm.** Contact the CDMO support team at cdmosupport@belle.baruch.sc.edu to obtain your username and password if you do not have it. The CDMO website can set a cookie to remember your username and password if you check the **Remember Me?** box. Click **Log into CDMO** to continue.

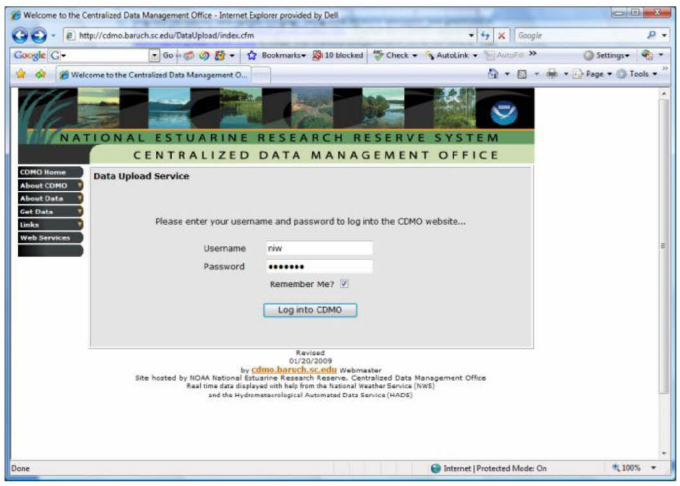


Figure 62. Log into CDMO

2) **Designate the type of data you wish to upload to the CDMO by choosing the MET and RAW radio buttons.** Enter a valid email address so that the primary QAQC'd data file can be emailed to you. You will use this file to conduct your secondary QAQC using the tools provided by the CDMO. Click on the **Continue** button to proceed.

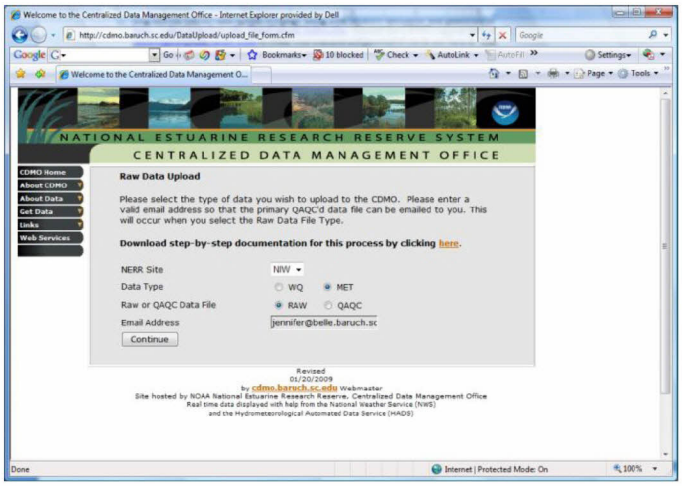


Figure 63. Specify type of data to upload

3) **Specify the file to upload to the CDMO.** The NERR Site is provided based on the initial login. The Sampling Stations drop down list will be populated based on the data type chosen on the previous page.

   a. Choose the sampling station and year of data that you are uploading. A copy of the raw file you upload will be placed in the appropriate yearly raw data folder on the CDMO FTP server. For example, if you are uploading a 2009 NIW MET file, a copy of the file will automatically be placed into the North Inlet Winyah Bay/meteorological/data/raw/2009 file folder on the CDMO FTP server. If your file contains data spanning two years, you should upload the file under both years to ensure that it is archived properly. **This step satisfies your raw data submission requirement automatically.**

   b. Use the **Browse** button to locate the file on your computer.

   c. Click on the **Upload** button to proceed.

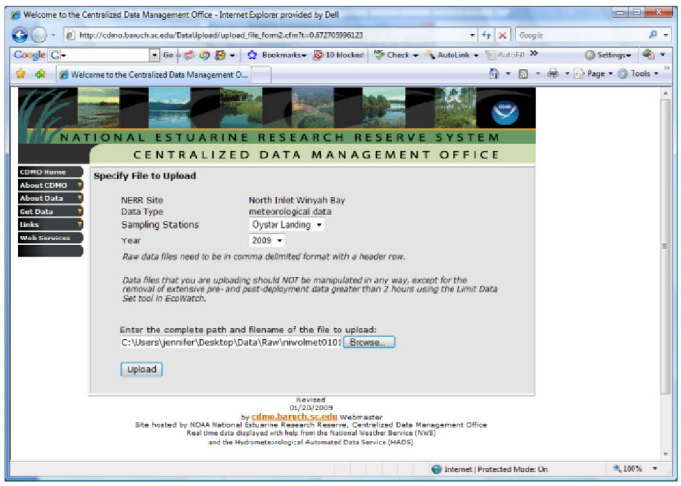


Figure 64. Specify file to upload

4) The file will now be checked against the CDMO database of required SWMP parameters and header information will be extracted.

a. **Troubleshooting:** If the file is not in comma delimited format or does not have the right header information, such as a units row, you will receive a **"Process aborted"** alert. If you need assistance, contact the CDMO support team at cdmosupport@belle.baruch.sc.edu.

5) **You will now be asked to verify the parameters in your data file.** If there are any parameter headers that do not match the CDMO database of required SWMP parameters, you will have an opportunity to identify those parameters. Only the designated SWMP parameters will be ingested into the CDMO database, go through primary QAQC and subsequently be made available as provisional data on the CDMO website. All **Non Standard Parameter** data will be returned to you in the primary QAQC'd data file to assist with a more thorough secondary QAQC.

a. **Required MET SWMP parameters include:**

Air temperature, relative humidity, barometric pressure, wind speed, wind direction, maximum wind speed, maximum wind speed time, standard deviation of wind direction, total precipitation, total PAR, and cumulative precipitation

Optional MET SWMP supported parameters include:

Total solar radiation

b. Use the drop down list to match up any unidentified parameters in your file with the correct table reference. If it is a non-required SWMP parameter make sure **Non Standard Parameter** is chosen.

c. Where the file contains MaxTemp, MaxTempT, MinTemp, MinTempT and AvgVolt, you must choose **Non Standard Parameter.**

d. If the file contains an optional SWMP supported parameter, such as total solar radiation, you may choose to designate it as a **Non Standard Parameter** so that it will not be added to the CDMO ODIS, or you may choose the TotSoRad table reference from the drop down list for inclusion in the database and primary QAQC.

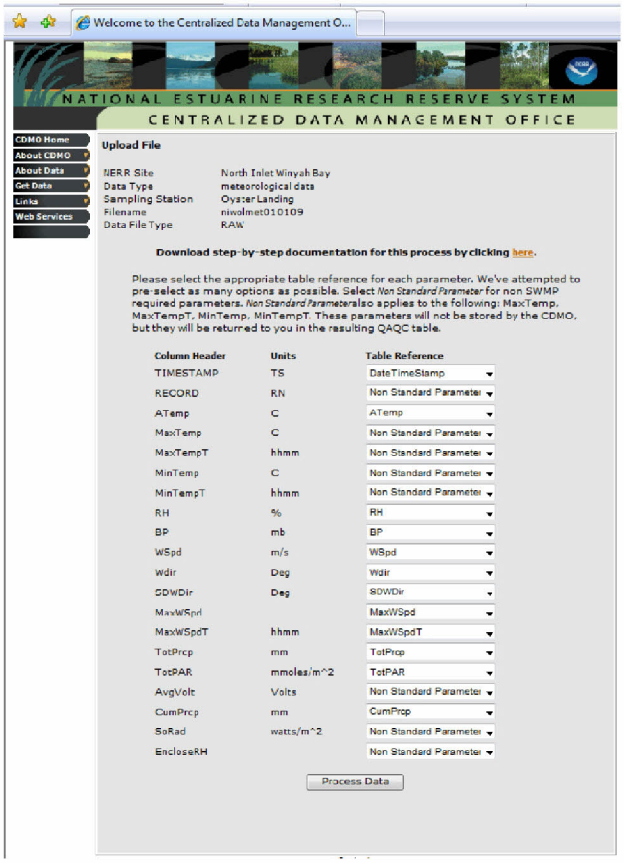


Figure 65. Verify parameter names

e. Once all the parameters have been correctly identified, click the **Process Data** button for the data to be imported into the CDMO database.

6) **The following actions occur as the data are ingested into the CDMO database**:

a. The date and times are corrected to read exactly on the quarter hour. This eliminates the appearance of duplicate data on the website and in the database.

b. As the data go through primary QAQC, flag columns are inserted after every required or optional SWMP parameter and given a header preceded by a F_. Each value is checked and a QAQC flag inserted into the parameter flag column.

7) Once the raw data have been successfully uploaded to the CDMO, you will be notified of the number of records that were inserted into the CDMO database. Click the **Upload more files** button to upload additional files to the CDMO.

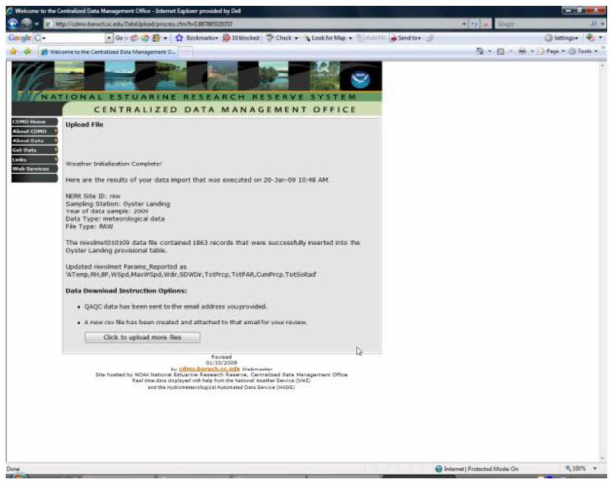


Figure 66. Upload complete

8) **The processed file will now be emailed[23] to you**. You will use this file to conduct your secondary QAQC using the **NERRQAQC.xls** Excel macro provided by the CDMO. Note that the primary QAQC'd file has been renamed with a "_QC" appended to the end of the filename.

   a. Open the email and save the attached data file to a folder that specifically contains primary QAQC data from the CDMO.

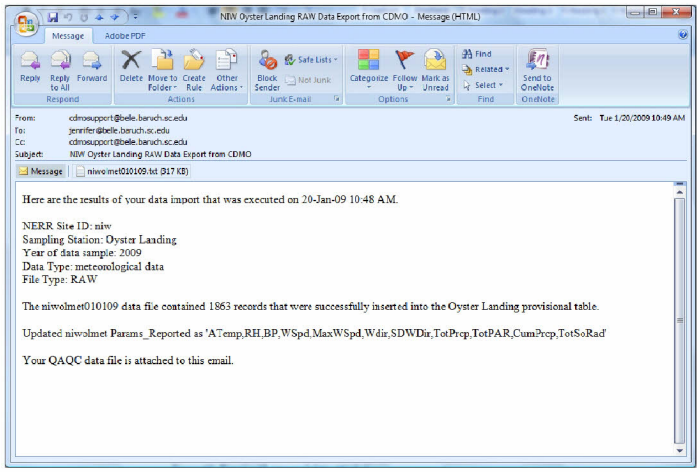


Figure 67. Email with processed data attached

9) The primary QAQC'd file is now ready for secondary QAQC.

[23] Email delivery time should occur within a few minutes of a successful data upload.

Meteorological data management: secondary QAQC

During primary QAQC, QAQC flags are automatically entered into the dataset flag columns to indicate if data are out of sensor range or, missing.

During secondary QAQC at the Reserve, QAQC flags and codes are entered directly into the dataset with the use of the NERRQAQC macro to provide additional data documentation. These QAQC flags and codes thus become metadata for the data, making this documentation more accessible to the user and reducing the amount of written documentation that must accompany the dataset.

Secondary QAQC flags

-3 **Rejected data:** Used during secondary QAQC to indicate a rejected value. **No data values are to be removed from the dataset under any conditions.**

-2 **Missing data:** Used during primary and secondary QAQC where a value is missing (not collected).

-1 **Optional SWMP supported parameter:** Inserted by the CDMO to indicate an optional parameter that was not collected.

1 **Suspect data:** Used during secondary QAQC to indicate a suspect value.

5 **Corrected data:** Used during secondary QAQC to indicate a value that has been corrected or changed[24].

When to use QAQC flags

Secondary QAQC flags should be applied to any data considered to be rejected, suspect, or corrected.

Primary QAQC flags of **-4** or **-5, indicating values that are out of instrument range, must be replaced with either -3 or 1 flags**.

You cannot apply a 0 flag over any primary QAQC flag.

Only one QAQC flag is allowed per value.

[24] The worksheet will have to be unprotected in order to correct the data.

Secondary QAQC codes

QAQC codes are used during secondary QAQC to allow for further documentation of the data. QAQC codes fall into three categories:

1) **General errors:** Used to document general problems with the deployment or common instrument related errors. Cannot be used in combination with a sensor error code.

GIM	Instrument malfunction[25]
GIT	Instrument recording error, recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GMT	Instrument maintenance
GPD	Powered down
GPF	Power failure/low battery
GPR	Program reload
GQR	Data rejected due to QAQC checks; *this is a catch all to be used if there isn't a specific QAQC code listed for the problem*
GSM	See metadata

2) **Sensor errors:** Used to document common sensor specific problems. Cannot be used in combination with a general error code.

SIC	Incorrect calibration constant, multiplier or offset
SNV	Negative value
SOC	Out of calibration
SSN	Not a number/unknown value
SSM	Sensor malfunction
SSR	Sensor removed

3) **Comments:** Can be used alone or in combination with a general error or sensor error code to further document conditions or a problem with the data.

CAF	Acceptable calibration/accuracy error of sensor
CDF	Data appear to fit conditions
CRE	Significant rain event
CSM	See metadata
CVT	Possible vandalism/tampering

The QAQC codes available for use during secondary QAQC are accessible from the **Apply Flag Codes** tool within the NERRQAQC macro. These codes cover the most common problems encountered with the NERR SWMP data. The "CSM" see metadata comment code can be applied to the data to cover additional problems that do not have their own QAQC codes, or that require a more detailed explanation, and are further documented in the Microsoft Word metadata document that will accompany your dataset. To request additional codes, contact the CDMO data management team at cdmo@belle.baruch.sc.edu. If the majority of the NERR community is in agreement, we will include them in the next release of the NERRQAQC macro.

[25] CR1000 related malfunctions.

When to use QAQC codes

A QAQC code must be applied to any data flagged as -3, 1, or 5 for documentation purposes. Remember, there will be no -4 or -5 QAQC flags in the secondary QAQC'd data as these flags must be replaced with either -3 or 1.

A maximum of two QAQC codes are allowed per value. A general error code cannot be used in combination with a sensor error code and vice versa. You must choose the most appropriate general or sensor error to use when documenting a value. However, a comment code can be used in addition to a general error or sensor error code.

Considerations before conducting secondary QAQC

Be sure to have the most up to date version of the NERRQAQC macro.

No data values are to be removed from the dataset under any conditions. Rather, the use of QAQC flags will indicate whether a value has been flagged as suspect, rejected or if the value has been corrected.

You do not need to delete any non-standard parameters in your dataset prior to or after conducting secondary QAQC. Non-standard parameters will not have an associated flag column after primary QAQC and the CDMO simply will not ingest them when the secondary QAQC'd file is submitted.

IMPORTANT: Remember that 5-second data are stored in order to generate averages, maximums and minimums, and totals every 15 minutes. Therefore, after a program reload, the 5-second data that were being held in storage are lost resulting in inaccurate averages, maximums and minimums, and totals for that quarter hour that the reload occurred, hence the data will need to be flagged as rejected <-3> in the database and coded appropriately.

You will need to periodically save the Excel data workbook because it is the working QAQC file. Saving the file as an Excel workbook will allow you to continue QAQC on the file at any time and preserve a record of all the metadata sheets.

Overview of the NERRQAQC macro

The NERRQAQC macro will perform the following tasks:

1) **Step 1: Open Data File**
    a. Allow the user to open the primary QAQC data file emailed from the CDMO.
2) **Step 2: Enter Station Code**
    a. Allow the user to insert the station code into the dataset.
    b. Combine the Date and Time columns into one DateTimeStamp column.
    c. Format the data according to the specifications in the overview of data collection section.
    d. Insert missing records into the dataset where the CR1000 did not collect.
    e. Highlight any data that were flagged during primary QAQC with a yellow background.
    f. Insert metadata sheets for all QAQC flags and copy any data flagged during primary QAQC into the appropriate sheet.
    g. Protect the data columns.
3) **Step 3: Create Charts**
    a. Allow the user to automatically generate a single or dual parameter chart.
4) **Step 4: Apply Flag Codes**
    a. Insert QAQC flags and QAQC codes (general error codes, sensor error codes, comments) into the flag columns of the dataset.
    b. Undo any flagging if necessary.
5) **Step 5: Synchronize Metadata Sheets**
    a. Synchronize flagged data between the data and metadata sheets and update summary statistics to facilitate QAQC and metadata documentation.
6) **Step 6: Save as an Excel File**
    a. Saves your workbook as an Excel file.
7) **Step 7: Append Excel File**
    a. Append QAQC'ed Excel files together.
8) **Step 8: Export CSV File**
    a. Export the final QAQC'd file in .**CSV** (comma delimited) format.
9) **Run Statistics**
    a. Calculate min, max, average, and standard deviation for each parameter

Step 1: Open Data File

Use the **Open Data File** tool to open the primary QAQC MET data file emailed to you from the CDMO. Refer to the email from the cdmosupport@belle.baruch.sc.edu address titled "*your Reserve code and sampling station* RAW Data Export from CDMO".

1) Click on the **NERR QAQC Main Menu** button in the Excel toolbar.

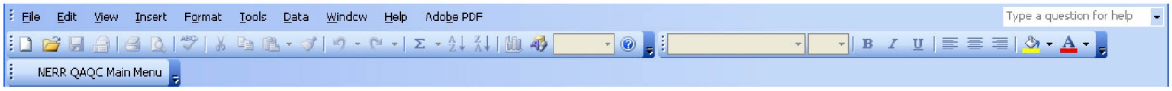


Figure 68. NERR QAQC toolbar

2) The **NERR QAQC Main Menu** window will open where you will launch each step of the macro to process the data. Note that you will have to open and close this menu as you work through each step.

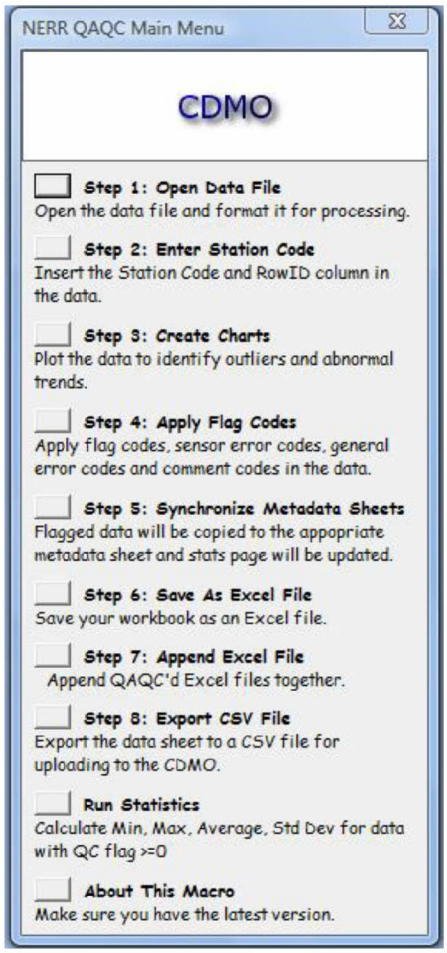


Figure 69. NERR QAQC main menu

3) Click on the **Step 1: Open Data File** button.

4) After activating the **Open Data File** tool, an **Open** file window will appear. Browse to the folder containing your primary QAQC'd data files, choose the file then select **Open.**

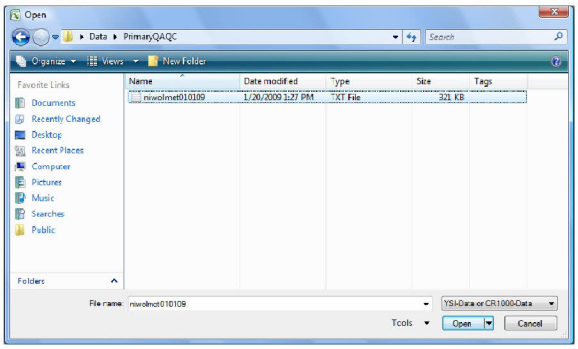


Figure 70. Open file window

5) The following window will appear once the file has successfully been opened.

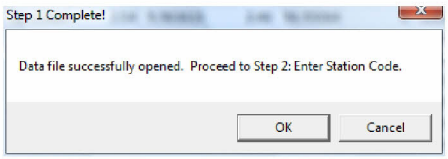


Figure 71. Step 1 complete window

6) Click **OK** to proceed to **Step 2: Enter Station Code**.

Step 2: Enter Station Code

The **Enter Station Code** tool will insert the station code into the dataset, format the data, and prepare the data file and Excel workbook for secondary QAQC by the Reserve.

1) Once the file has been opened with the **Open Data File** tool, the **Enter Station Code** tool will automatically launch and you will be prompted to insert the station code
    a. The station code conforms to the following naming convention: **the three letter NERR site ID, the two letter sampling station ID and the three letter data type (met)**.

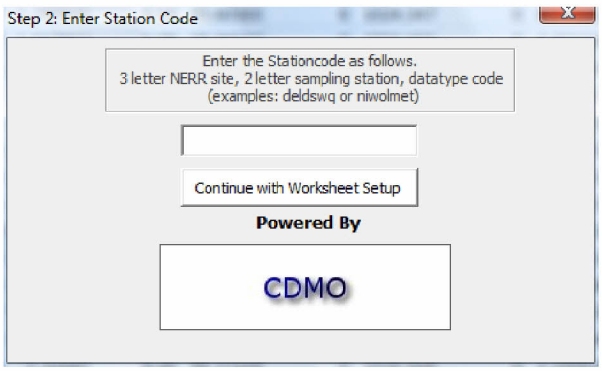


Figure 72. Enter station code prompt

2) Once the station code has been entered, select **Continue with worksheet setup** and the following will occur:

   a. A RowID column will be inserted as the first column of each row. This column is used to synchronize the flags and codes from the metadata sheet to the datasheet.

   b. The station code will be entered as the second column of each row.

   c. Missing records will be inserted where the CR1000 did not collect.

   d. The data will be formatted according to the format listed under the **Overview of data collection** section.

   e. Any flag values not equal to 0 in the flag columns will be enclosed with <> and highlighted in yellow to make discovery easier on the user.

   f. Flags for negative PAR values with in sensor range will be changed to <1> and coded (CAF).

   g. Metadata worksheets will be created within the Excel file and records containing each flag code (-5 through 5) will be copied into them.

   h. Every column except the flag columns will be protected. This will ensure the parameter values are not mistakenly changed or removed when applying QAQC flags or QAQC codes.

3) The following window will appear when the **Enter Station Code** tool has finished processing the data. Select **OK** and the **Create Charts** tool will automatically launch.

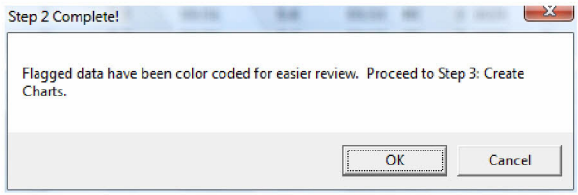


Figure 73. Step 2 complete window

4) The data will look like the figure below after processing.

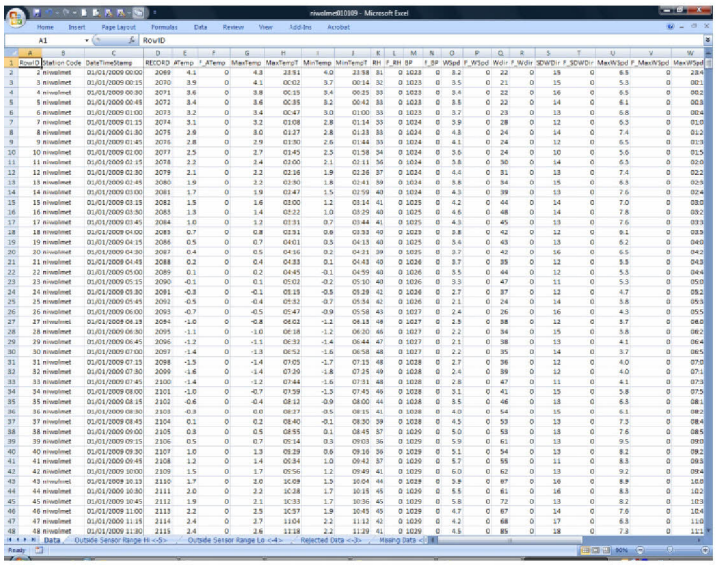


Figure 74. MET data after processing

5) **Save the Excel workbook!** To do this, you must close the **Create Charts** window and choose **Step 6: Save as Excel File** from the **NERR QAQC Main Menu** window. Name the data workbook (suggestion: niwolmet010109_QC) and save it in a dedicated directory for Secondary QAQC files. Do this periodically while working with each file. **This Excel workbook is your working QAQC file,** saving it as an Excel workbook will allow you to continue QAQC on the file at any time..

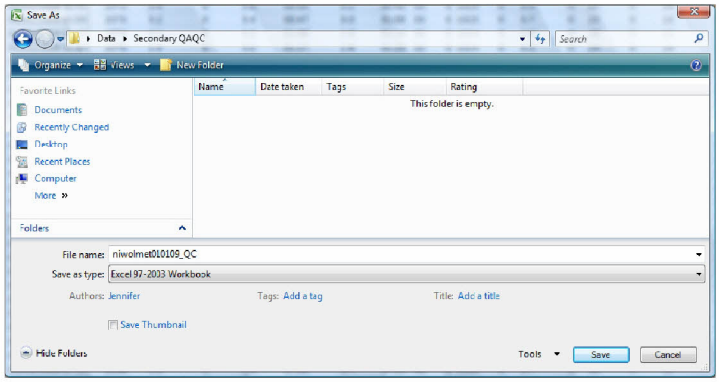


Figure 75. Save as window

Step 3: Create Charts

The **Create Charts** tool will allow you to easily create plots of any parameter in the data sheet.

1) After saving your work, reopen the **NERR QAQC Main Menu** and select **Step 3: Create Charts** to continue.
2) Option 1: Choose the Create **Charts for all Parameters** button to automatically generate charts for each parameter in your data file.
3) Option 2: Select two parameters to plot together from the drop down lists. Choose the **Create Chart for Specified Parameters** button to plot the data.

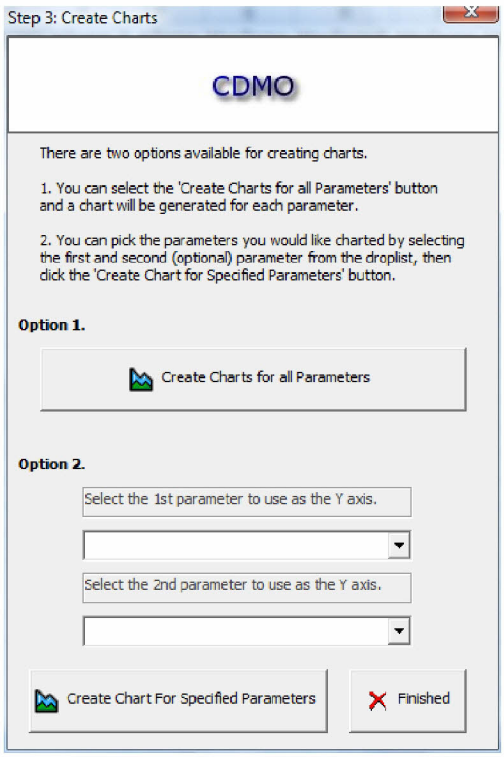


Figure 76. Create charts window

4) Each chart will appear in a new worksheet labeled with "chart" and the appropriate parameter(s).

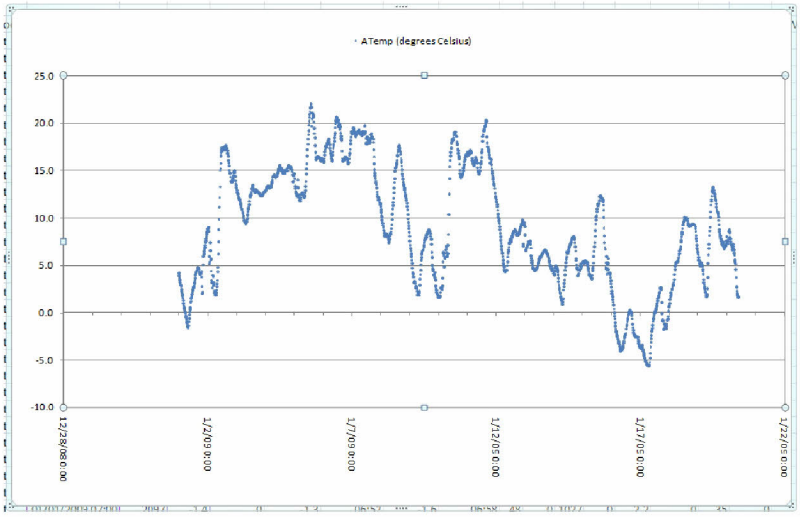


Figure 77. Air Temperature chart

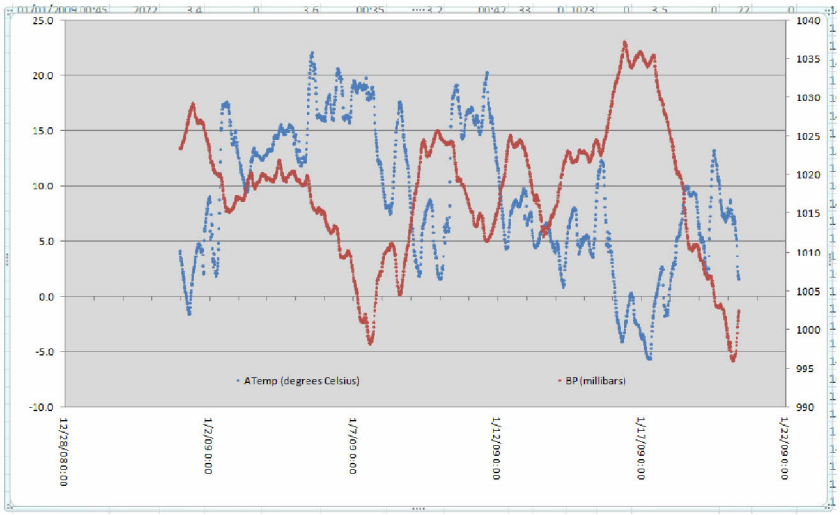


Figure 78. Temperature vs. Barometric Pressure chart

5) If you have plotted two parameters, you will need to select the second data series in the graph, right click and choose **Format Data Series,** then tab to the **Axis** tab and choose **Plot series on secondary axis**.

6) Once all desired charts have been created, close the **Create Charts** window and the **NERR QAQC Main Menu** to review each chart individually

7) You may need to make some minor formatting changes to your charts in order to view them better. The macro cannot format charts perfectly in multiple versions of Excel.

   a. In the charts above, the legend has been moved to the top of the chart (click on the legend and drag it to the desired location) and the x-axis dates have been rotated (right click on the x-axis, choose format axis, choose alignment, select horizontal for text direction).

   b. The chart itself can also be resized by selecting the chart (inside the window), "grabbing" a corner, and moving it until the appropriate size has been reached.

8) Inspect each chart and note any questionable data. Mouse over the chart to determine dates/times and data values for problem areas.

    a. If there are any missing data in the file, it will be represented by a gap in the graph. Tab to the missing data metadata sheet for a list of missing records in the file.

    b. Data flagged as rejected or out of sensor range are excluded from charts.

9) Once all questionable data have been identified, continue to the next step, applying flag codes to the data.

IMPORTANT: The charts must be deleted and recreated any time additional flags of less than 0 are applied to the Data sheet. In order to mask all data with flags of <0 in the charts, the data had to be filtered and copied into the individual chart sheets, thereby losing its link to the "data" sheet.

Step 4: Apply Flag Codes

The **Apply Flag Codes tool** will allow the user to document the data by inserting QAQC flags and codes into the parameter flag columns of the dataset. The primary QAQC'd data may have QAQC flags that need to be replaced or further documented with QAQC codes[26].

To launch the **Apply Flag Codes** tool,

1) Click on the **NERR QAQC Main Menu** button in the Excel toolbar.

Figure 79. NERR QAQC main menu

2) Click on the **Step 4: Apply Flag Codes** button.

3) The **Apply Flag Codes** window will open.

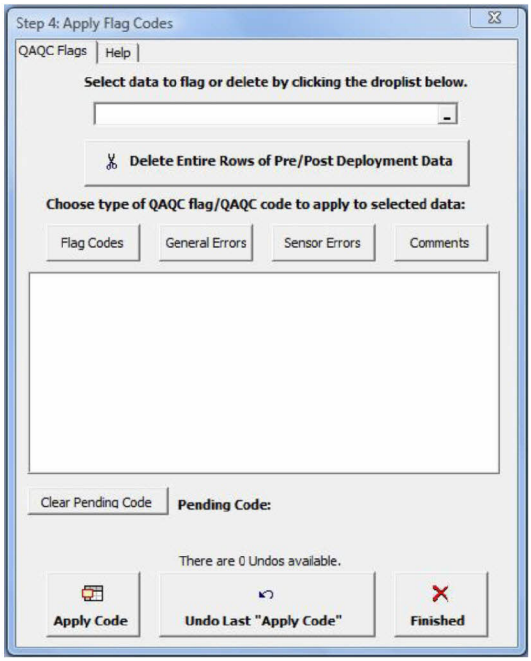


Figure 80. Apply flag codes window

[26] Out of sensor limit flags -5 or -4 must be replaced during secondary QAQC with -3 (rejected) or 1 (suspect) flags. QAQC flags other than -2 and 0 must be accompanied by a QAQC code.

Apply QAQC flags and QAQC codes to data

The **Apply Flag Codes** tool will facilitate the documentation of the data through the use of QAQC flags and QAQC codes. Remember that the QAQC flags and QAQC codes that you enter into the dataset act as metadata, therefore you want to be as thorough as possible when choosing a QAQC flag and QAQC code(s) to apply. The data can still be further documented in the Microsoft Word metadata document that will accompany your dataset during submission to the CDMO through the use of the **CSM see metadata** QAQC comment code.

The user will **choose the type of QAQC flag and QAQC code to apply to the selected data** from the following buttons: **Flag Codes**, **General Errors**, **Sensor Errors** and **Comments**. Refer to the QAQC flags and QAQC codes sections for a list of flags and codes to choose from, then choose the most appropriate to apply to the data.

Considerations before applying QAQC flags and codes

Remember that all -4 and -5 QAQC flags must be replaced with a -3, 1, or 5 flag.

Remember that **each -3, 1, or 5 flag must be accompanied by at least one QAQC code, but only one QAQC flag and two QAQC codes are allowed per value.** A general error code cannot be used in combination with a sensor error code and vice versa. However, a comment code can be used in addition to a general error or sensor error code.

When selecting the data, remember that the parameter column and its associated flag column can be selected, rather than just the flag column itself. **Because the parameter columns are protected, QAQC flags and codes will only be entered into the selected flag columns.**

QAQC flags and codes can be applied directly into the **metadata sheets** as well as in the data sheet.

To select contiguous records, select the range of parameter values and their associated flag values. You may select a range of records within the metadata sheet, even though the records are not contiguous in the data file.

To select non-contiguous records, select the first parameter value and its associated flag value then hold down the **Ctrl** key to select the remaining parameter and flag values[27]. Please note that there is a limitation with Excel when selecting non-contiguous records so try to flag data in small increments.

Remember that **General Error** codes are typically applied to an entire record while **Sensor Error** codes are typically applied to the affected sensor only. To further document the value, a **Comment** code can also be applied.

Applying QAQC flags and codes

1) **Review primary QAQC flags:** Data flagged during primary QAQC should be addressed first.
    a. Records flagged during primary QAQC are automatically copied to the appropriate metadata sheets during the **Enter Station Code** process.
    b. Tab through the out of sensor range and missing data metadata sheets to help identify problems with the data.

[27] This technique must be used when using the Autofilter function, which also requires that the worksheet be unprotected.

2) **Review charts for trends and outliers:** Refer to the charts you created and your notes and monthly log sheets as needed to diagnose problems with the sensors, calibration, etc.

3) When you are ready to document the flagged data with the appropriate QAQC flag or QAQC code, select **Step 4: Apply Flag Codes** from the **NERRQAQC main menu**.

4) **Apply secondary QAQC flags and codes:** With the **Apply Flag Codes** window open, select the data to flag by clicking on the minimize button in the **Select data to flag or delete by clicking the droplist below** window shown in the figure below.

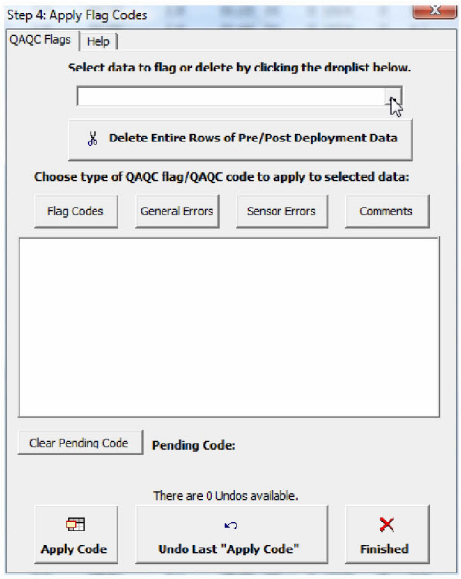


Figure 81. Select data to flag

5) The **Apply Flag Codes** window will collapse and leave the following data selection window open.

Figure 82. Data selection window

6) Select the data to flag in the metadata sheet or the data sheet, then maximize the data selection window to return to the **Apply Flag Codes** window.

   a. In the example below, relative humidity values of 104 and 105 were flagged in the **Outside Sensor Range Hi <-5>** metadata worksheet. Note that values can also be flagged in the metadata sheets.

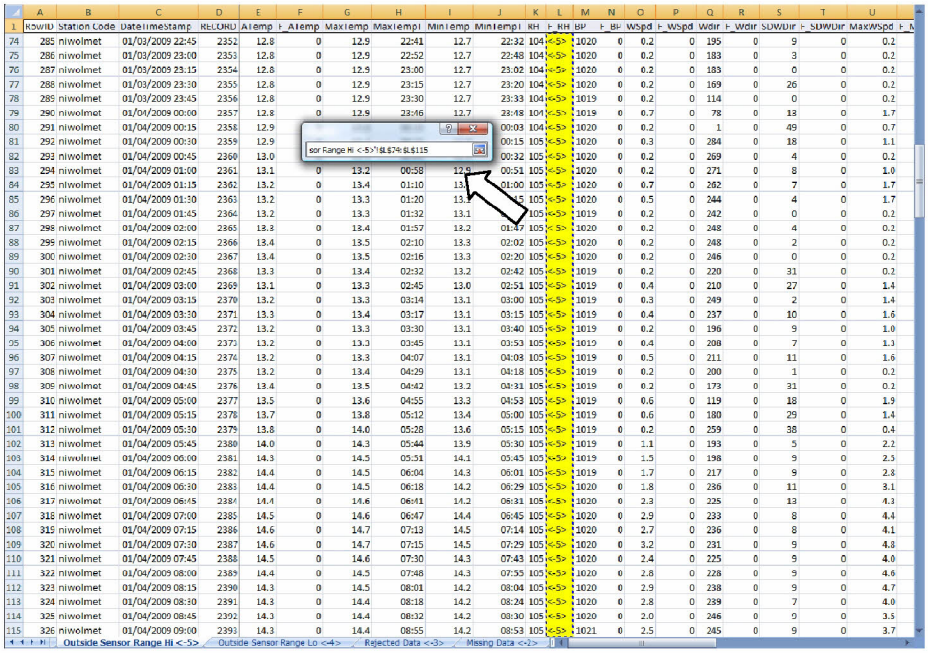


Figure 83. Data selected to flag in the data sheet

7) Select the QAQC flag to apply from the **Flag Codes** button. As you make a selection, the pending QAQC codes will be displayed next to the **Pending Code:** in the **Apply Flag Codes** window in red font.

   a. In this example, the relative humidity data should be flagged as **<-3> Data rejected** QAQC flag.

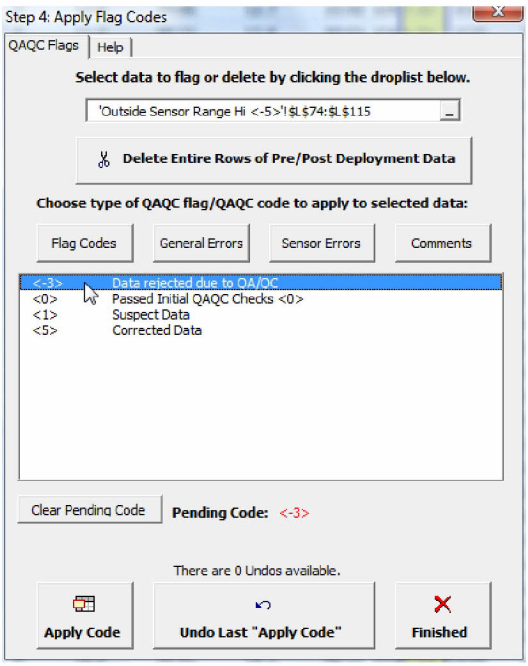


Figure 84. Applying rejection flag.

8) Next, select the appropriate QAQC code or codes to apply from the **General Errors**, **Sensor Errors** and/or **Comments** buttons first. As you make a selection, the pending QAQC codes will be displayed next to the **Pending Code:** in the **Apply Flag Codes** window in red font.

   Remember that you can also apply a **Comment Code** to a **General** or **Sensor Error Code** or use alone. A comment code can be used alone

   a. In this example, the wind speed data recorded as 104 and 105 will be flagged as **SOC out of calibration** from the list of **Sensor Error** QAQC codes

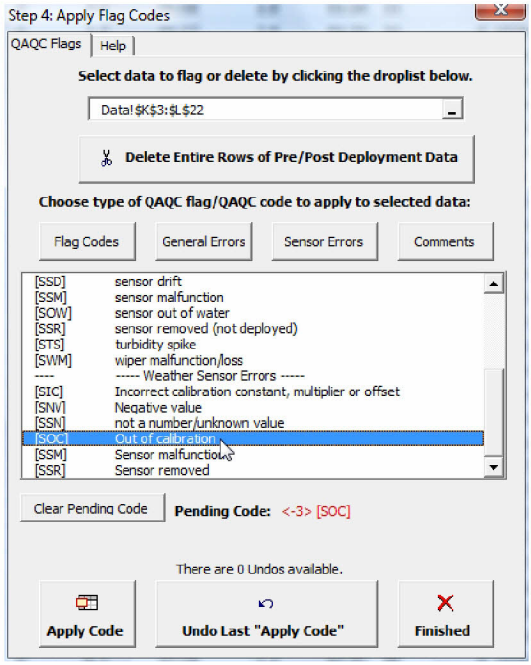


Figure 85. Selecting Sensor Error.

9) As you make your selections from the **Flag Codes**, **General Errors**, **Sensor Errors** and/or **Comments** buttons, you will see the **Pending Codes** change. When you are satisfied with the code to apply, select the **Apply Code** button to have the codes applied to the selected data.

10) If you need to clear the pending code to make another selection, select the **Clear Pending Code** button.

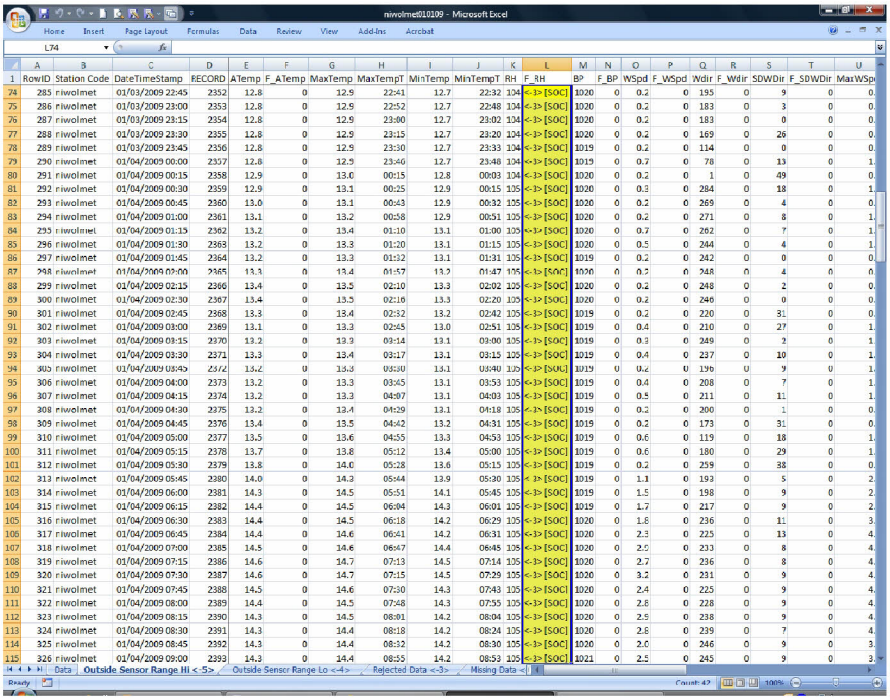


Figure 86. Data with code applied

11) Continue reviewing your data, flagging and coding as necessary.

    a. If you would like to update your metadata sheets to help keep track of the data you have flagged and coded, skip ahead to **Step 5: Synchronize Metadata Sheets**.

    b. You may also want to update your charts (by deleting and recreating them) to reflect data that have been rejected.

12) Exit the flagging tool by choosing the **Finished** button and save the Excel workbook using the **Step 6: as Save Excel File** tool.

Removing QAQC flags and codes

1) If you need to undo a QAQC flag or QAQC code that was applied, use the **Undo Last "Apply Code"** button. You will see a running total of the amount of "Undo" operations available above the **Undo Last "Apply Code"** button. It will keep track of all flags and codes that were entered into the dataset while the file has been open, however if you close the file or open another file to process, the undo operations will be cleared from memory.

2) If you need to remove existing codes that were applied during a previous QAQC session, choose "**Remove existing general error code**" from the General Errors list, "**Remove existing sensor error code**" from the Sensor Errors list, or "**Remove existing comment code**" from the Comment Code list of the **Apply Flag Codes** window.

Step 5: Synchronize Metadata Sheets

Use the **Synchronize Metadata Sheets** tool to copy all data records with newly applied QAQC flags and codes into the appropriate metadata worksheet and update summary statistics. This will facilitate the QAQC process by providing access to all data with a particular flag in one location and help to ensure that all necessary flags are addressed with an appropriate code.

1) Use the **Synchronize Metadata Sheets** tool to synchronize secondary QAQC flags and codes between the data sheet and the metadata sheets. Do this by opening the **NERR QAQC Main Menu** and choosing the **Step 5: Synchronize Metadata Sheets** button. The following window will appear. Choose **Synchronize Now** to proceed.

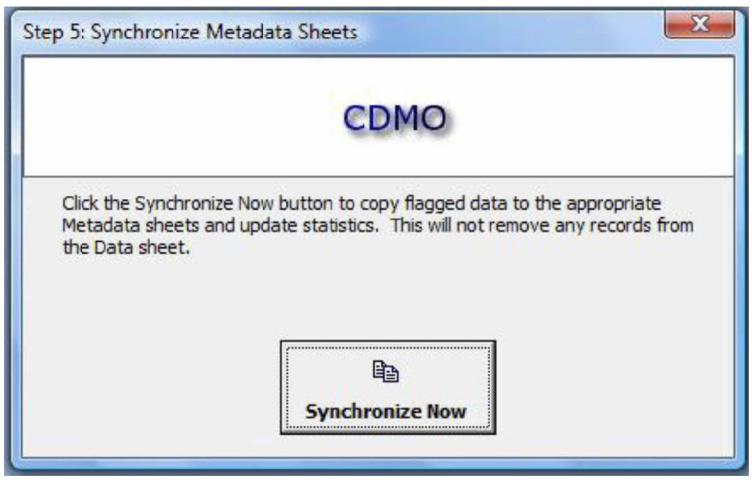


Figure 87. Synchronize metadata sheets

2) Each record containing a flag value other than 0 will be copied into their respective metadata worksheets, as is done automatically during Step 2: Enter Station Code.

   a. Data with flags of 0 will not be copied into the Passed Initial QAQC Checks metadata worksheet unless a comment code has been applied, in which case the flag would change from 0 to <0> and be copied.

   b. Entire records are copied to provide full context for QAQC, not just the parameter with the flagged values.

3) The following window will appear when all records have been copied into their respective worksheets.

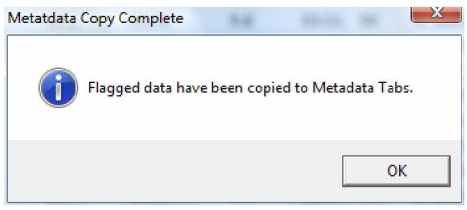
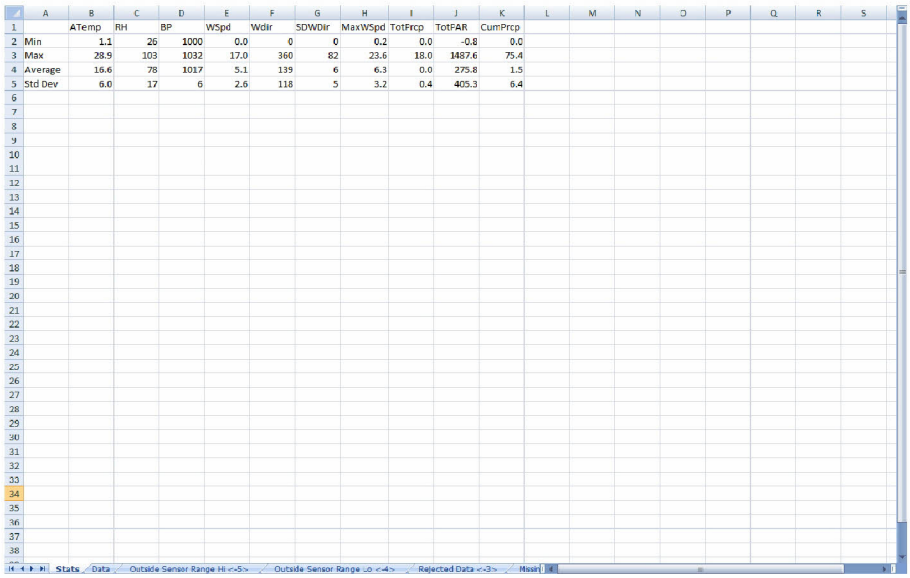


Figure 88. Metadata copy complete window

4) Select the **OK** button. A metadata sheet containing summary statistics will either be created or updated at the first tab. Statistics include min, max, average, and standard deviations and exclude all data with QAQC flags less than zero.

a. Check statistics page to verify that all outliers have been addressed.

b. The statistics tool can also be run independently to either create or update the statistics page at any time.



	ATemp	RH	BP	WSpd	Wdir	SDWDir	MaxWSpd	TotPrcp	TotPAR	CumPrcp
Min	1.1	26	1000	0.0	0	0	0.2	0.0	-0.8	0.0
Max	28.9	103	1032	17.0	360	82	23.6	18.0	1487.6	75.4
Average	16.6	78	1017	5.1	139	6	6.3	0.0	275.8	1.5
Std Dev	6.0	17	6	2.6	118	5	3.2	0.4	405.3	6.4

Figure 89. Statistics metadata sheet

5) Tab through the metadata sheets looking for any QAQC flags or codes that you may have missed.

b. Verify that all -4 or -5 flags applied during primary QAQC have been replaced.

c. Verify that all -3, 1, or 5 QAQC flags are accompanied by at least one QAQC code.

6) When all the desired QAQC flags and codes have been applied, make sure to uses the **Synchronize Metadata Sheets** tool one last time to create a final version of your metadata sheets.

5) Save the Excel workbook using the **Step 6: as Save Excel File** tool. If desired, the metadata sheets can also be copied and pasted into the Microsoft Word metadata document to be submitted with the finalized data to the CDMO.

Step 6: Save as an Excel file

This Excel workbook is your working QAQC file. Saving it as an Excel workbook will allow you to continue QAQC on the file at any time, as well as preserve the deployment records metadata sheet. Save the file periodically to avoid losing any of your work.

1) Choose **Step 6: Save as Excel File** from the **NERR QAQC Main Menu** window. The Save As window will appear.

2) Name the data workbook appropriately. Consider using the original QC file name followed by a 2 to indicate secondary QAQC (niwolmet011509_QC).

3) Navigate to a dedicated directory for Secondary QAQC files, and choose Save.

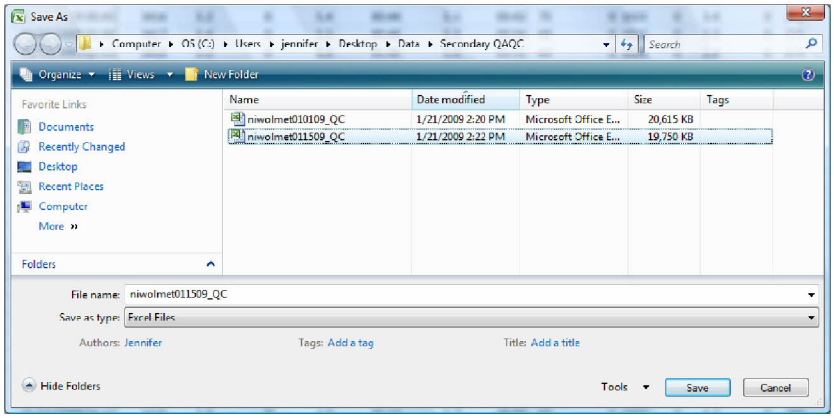


Figure 90. Save as an Excel File

4) When your file has been saved, the following window will appear detailing its name and location.

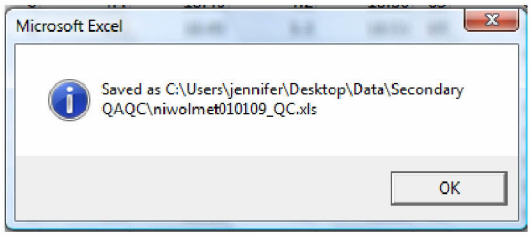


Figure 91. File saved window

Step 7: Append Excel File

For each station, you will need to append your deployment QC files together into quarterly files for quarterly submission and a yearly file for final submission to the CDMO. There are a few things to remember before you begin appending.

You must ensure that there are no overlapping records between deployment files. Remove these records using the "remove pre and post deployment tool" prior to appending.

Quarterly and yearly files must not span multiple years. If your deployment file carries over into the following year, it must be split into the appropriate year for quarterly and yearly file submission. **However, if deployment files span into another quarter, they do not need to be split.**

You may include non-required SWMP parameters such as diagnostic information or optional parameters in the file.

You must ensure each file has the same output order and parameters. If you did not ensure that the parameters were exported in a consistent order, open each QC file in Excel and shift the columns so that the order is consistent between files, then resave each one.

If you began collecting an optional SWMP supported parameter during the quarter or year, you may still include this data. Insert a column and the correct header at the appropriate place in the files missing the parameter. Leave the cells empty. This will ensure file consistency and allow you to include a partial quarter or year of the new parameter data.

Appending deployment or quarterly files.

1) Open the first file you will append to by choosing **Step 1: Open Data File** from the **NERRQAQC Main Menu**.
    a. If you are appending deployment files into quarterly files, open the first deployment file of the quarter.
    b. If you are appending quarterly files into a yearly file, open the first quarter appended file.
2) Choose **Step 7: Append Excel File** from the **NERRQAQC Main Menu**. The open file window will appear. Select the file to be appended to your open file.

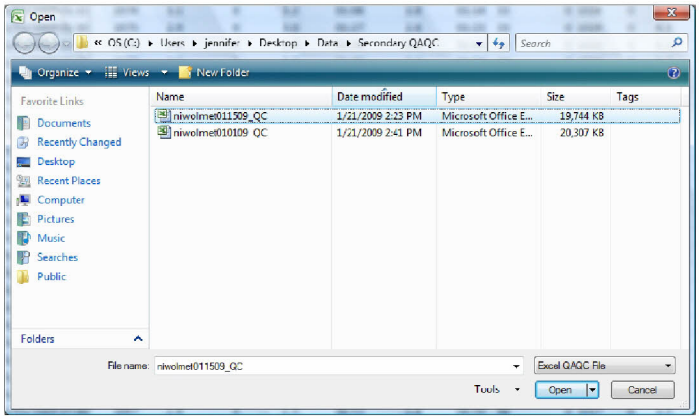


Figure 92. Open file to append window.

3) The macro will verify the new file's structure to ensure that it has been through secondary QAQC and formatted by the NERRQAQC macro. Once the file structure has been verified, the following window will appear. Select OK to continue.

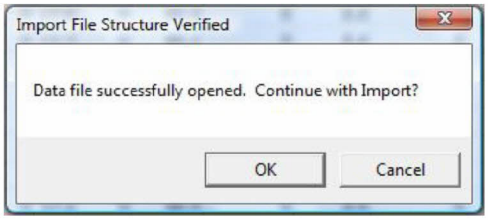


Figure 93. File structure verified window

4) The macro will then check the files for compatibility. If the files are not compatible, the file import will be cancelled.

   a. If the files don't have the same number of parameters, you will receive the following error message.

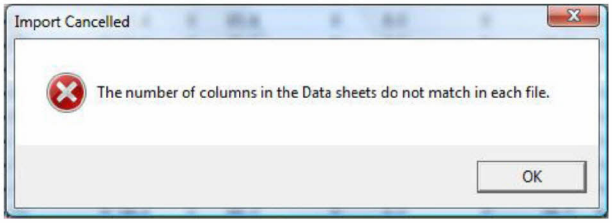


Figure 94. Import cancelled window

   b. If the parameters are not in the same order, you will receive the following error message.

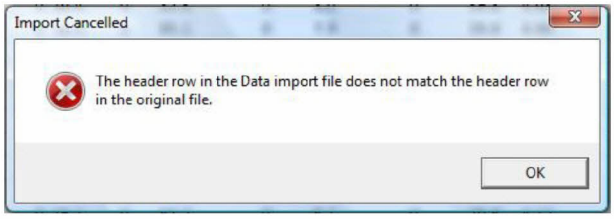


Figure 95. Import cancelled window

c. If your files have overlapping records, you will receive the following error message.

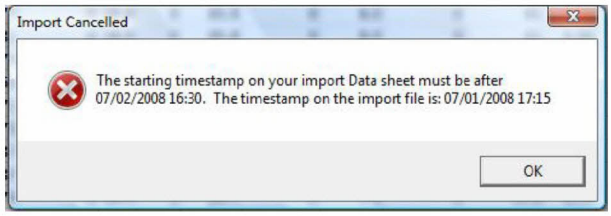


Figure 96. Overlapping records window

d. Return to your files to determine what the problem is and shift parameter columns, add a column for an additional parameter, or remove overlapping deployment data so that your files are compatible.

5) If your files are compatible, the following success window will appear. Select **Yes** and the **Synchronize Metadata Sheets** tool will be launched.

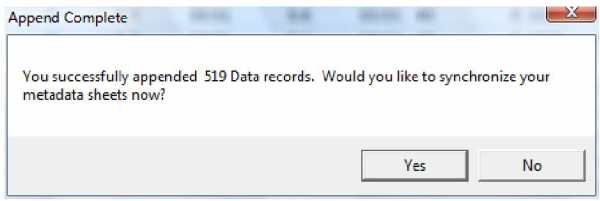


Figure 97. Append complete window

6) Select **Synchronize Now** from the Synchronize Metadata Sheets window and the metadata sheets will be synchronized for the newly appended file.

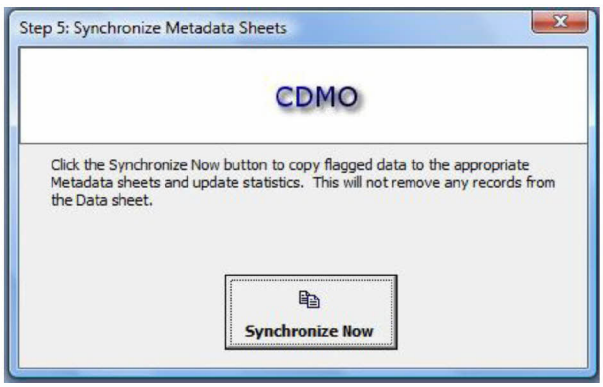


Figure 98. Synchronize metadata sheets window

7) When synchronization is complete, the following success window will appear. Select **OK**.

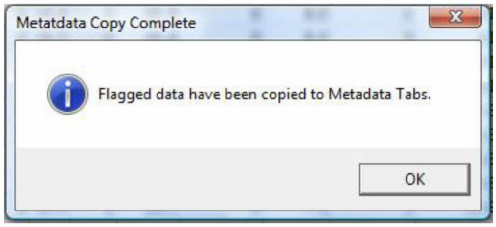


Figure 99. Metadata copy complete window

8) Deployment Records only pertain to WQ data. Select OK.

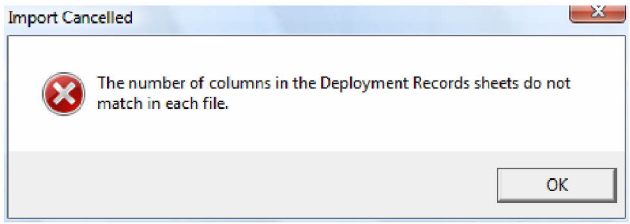


Figure 100. Deployment Records

9) Close the NERRQAQC Main Menu and scroll through your Data sheet, noting where the new data have been appended. If necessary, missing records will be inserted and flagged automatically.

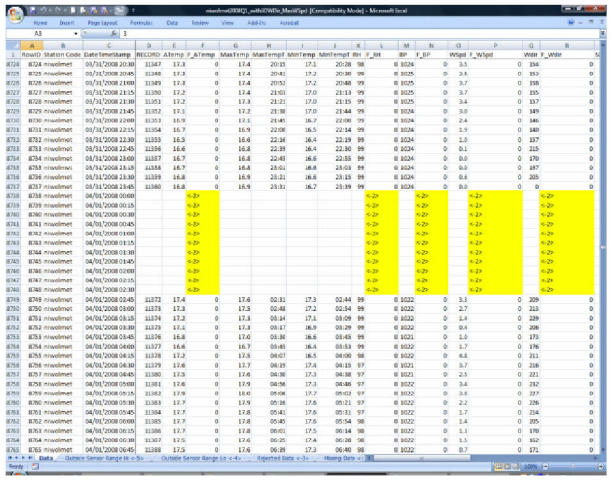


Figure 101. Appended data

10) Go to **Step 6: Save As Excel File** and save your appended file in a dedicated directory for quarterly or yearly files, naming it following the appropriate naming conventions.

   a. For quarterly files, name the file with the 3 letter reserve code, two letter sampling site code, data type code, 4 digit year and Q# (niwolmet2008Q1).

   b. For yearly files, name the file with the 3 letter reserve code, two letter sampling site code, data type code, and 4 digit year (niwolmet2008).

13) The deployment or quarterly file that you just added to your appended file will remain open after your append is complete. Close the file to avoid confusion.

14) Continue appending files until you have compiled a complete quarterly or yearly file, saving the XLS file often throughout the process and when it is complete.

Final review of appended secondary QAQC files

Once you have compiled a complete quarterly or yearly file, open the file in the **NERRQAQC macro** for final review and charting.

1) Open the appended file with the **Step 1: Open Data File** tool.

2) Chart each parameter with the **Step 3: Create Charts** tool. Review the file for new trends and outliers visible with the addition of the new deployment data.

3) Apply additional QAQC flags or QAQC codes to the data with the **Step 4: Apply Flag Codes** tool.

4) Synchronize the metadata and data sheets using the **Step 5: Synchronize Metadata Sheets** tool and verify that all data are flagged and coded properly.

5) Save the final workbook in XLS format using the **Step 6: Save As Excel File** tool.

6) Export the final quarterly or yearly file in CSV format for submission, using the **Step 8: Export CSV File** tool.

Step 8: Export CSV File

After secondary QAQC, appended quarterly and yearly files must be exported as CSV files for submission to the CDMO, where they will be posted as provisional plus data on the CDMO ODIS.

Remember that once exported, the .CSV file should not be edited further with the NERRQAQC macro. If you need to edit your data, you must go back to your final working Excel data workbook to make your edits, then re-export the file.

1) When you are ready to export the final QAQC'd file as a comma delimited .**CSV** file, choose the **Step 8: Export CSV File** button from the **NERR QAQC Main Menu**. The export CSV file window will appear.

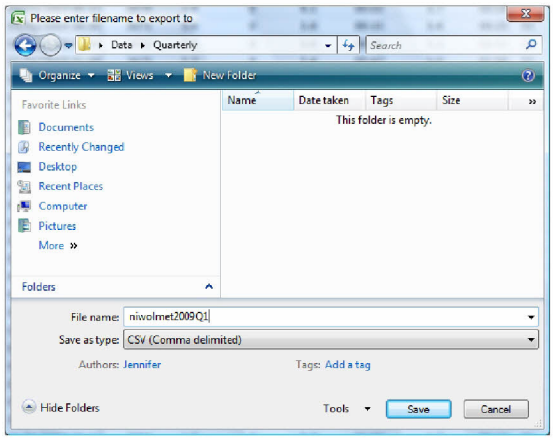


Figure 102. Export to .CSV file

2) Save the file to your dedicated directory for quarterly or yearly files. Name the file following the naming conventions required by the CDMO.

   a. Your quarterly or yearly XLS file and exported CSV version of this file should have the same name (other than the file type designation). This will help to avoid confusion if you need to go back to the XLS file to make further edits.

3) The following window will open verifying that the 15-minute records should be exported. Choose **Yes** to export the 15-minute records **required for submission to the CDMO**.

   a. You may re-export the data and choose **No** if you would also like the 30-minute records (only) exported in CSV format for use at the Reserve.

   b. Make sure to name any file containing only 30-minute data appropriately to distinguish it from your complete file.

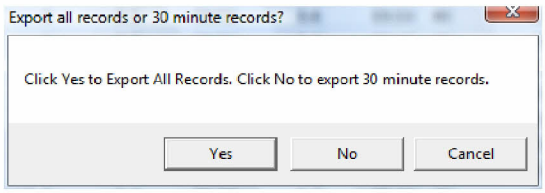


Figure 103. Exporting Records window

4) Submit the quarterly or yearly exported data file to the CDMO according to the timetable for submission in **Table 5. Secondary QAQC Submission**, located at the beginning of Chapter 7.

   a. Required quarterly naming convention is the three letter reserve code, two letter station code, four digit year, and Q#. Ex. niwolmet2009Q1

   b. Required yearly file naming convention is the three letter reserve code, two letter station code, and four digit year. Ex. niwolmet2009

Frequently asked questions

Q: What primary QAQC flags do I have to change?
A: *You must change any out of sensor limits flags (-4 or -5) to suspect or rejected (1 or -3). Any of the discontinued outside 2 or 3 standard deviations from the historical seasonal mean flags (2 or 3) can remain in the data file or be changed to 1 or -3 as appropriate. The CDMO will remove these flags during tertiary review.*

Q: Why aren't all the data with primary QAQC flag values of 0 being copied into the Passed Initial QAQC Checks metadata worksheet?
A: *Data with flags of 0 will not be copied into the Passed Initial QAQC Checks metadata worksheet unless a comment code has been applied, in which case the flag would change from 0 to <0> and be copied.*

Q: Do all flagged data need to have a QAQC code applied?
A: ***All data flagged as -3, 1, or 5 must have a QAQC code.*** *Choose the most appropriate QAQC code to apply; a general or sensor error and/or a comment code.*

Q: Why won't the macro let me apply a general error and sensor error code into the same cell?
A: *You must choose to apply either a general error code OR a sensor error code, not both. However a comment code can be used in conjunction with either a general or a sensor error code.*

Q: What QAQC flag and QAQC code should I use if I have relative humidity data of 101-103% that are flagged as out of sensor range (-4 or -5)?
A: *These data are suspect, but may be acceptable. If appropriate, use the suspect data <1> QAQC flag code and the CAF acceptable calibration/accuracy error Comment QAQC code.*

Q: What QAQC flag and QAQC code should I use for missing data due to a program reload or power down?
A: Missing data due to a program reload or power down should be flagged -2 and coded for either a power down (GPD) or program reload (GPR). Data that are rejected due to missing 5-second data as a result of a program reload or power down should be flagged as rejected (-3) and coded appropriately.

Q: How do I change a value if I need to correct it?
A: *You must unprotect the worksheet by choosing* ***Tools>Protection>Unprotect sheet*** *from the menu then make the change to the data point.*

Meteorological metadata management: data documentation

The most important part of data collection is creating the associated data documentation or metadata. Metadata explains all aspects of the data from the research objectives to the data QAQC and should be created as each data set is processed.

The Microsoft Word metadata document that must accompany the dataset will contain a list of all QAQC flags and codes used in the dataset. These embedded flags and codes are an important component of the dataset's metadata. However, since these codes are not always adequate for complete documentation, there will be a section available in the metadata to detail important information about the dataset. Data users may be pointed to the metadata document for these more detailed explanations with the use of the **CSM "See Metadata"** QAQC code. Reserves must use the new metadata templates for 2008 data submission.

Meteorological metadata tips

(1) The CDMO will not accept any data submitted without the corresponding metadata.

(2) Metadata must document one calendar year of data. Include all meteorological sites in one metadata file for each year. Be sure to include any changes to the protocol, maintenance, site changes or calibration procedures with a date that the change occurred.

(3) Use the data type code to indicate what type of data the metadata refers to. There are currently three data types: **wq** to indicate water quality data, **met** to indicate meteorological data, and **nut** to indicate nutrient data.

(4) Name the metadata document using the following filename code that indicates the NERR site and what months and year the metadata document covers. (For example, if the metadata filename is nocmet01-12.03m, it tells the CDMO that the file is a meteorological metadata file for the NOC NERR and covers the months of January - December of the year 2003).

(5) List at the top of the metadata document (under the Title), the months that the metadata covers. List the **Latest update** date to the metadata documentation. Every time that the metadata is edited, the date that the edits took place should be listed at the top of the metadata form page.

(6) Be sure to update the sensor specification section which includes more detailed information on models used, their respective specifications and calibration dates. This is very important information for any user of the data.

(7) Save your metadata file as a **Microsoft Word document** before sending to the CDMO server.

Meteorological metadata template

Reserve Name (include 3 letter code here) **NERR Meteorological Metadata**
Months and year the documentation covers
Latest Update: Date that the last edits were made

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons – List the staff members responsible for the design, implementation and continuation of the data set. Include name, title, mailing address, phone number, and email address for the Research Coordinator, SWMP technicians, and person(s) responsible for data management.

2) Entry verification – This section explains how the data were verified (QAQC'd) before being sent to the CDMO to be archived into the permanent database. Specifically, list how your data are acquired, validated, processed, and archived. Mention how your reserve deals with outliers, suspect and erroneous data during secondary QAQC, etc. Use the following statement or modify to fit your Reserve:

> Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from or LoggerNet in a comma-delimited format and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. For more information on QAQC flags and QAQC codes, see Sections 11 and 12.

Remember to list the person(s) responsible for data management.

3) Research objectives – Describe briefly the nature of the monitoring program resulting in this data set. Describe the goal or purpose of collecting this meteorological data.

4) Research methods – Detail the specifics of data collection and collection intervals, QAQC of the sensors and data, the sensor calibration plan and any other analysis on the data. Include the following or similar excerpt (modify for additional real-time sites) regarding real-time data:

> Campbell Scientific data telemetry equipment was installed at the (*insert station name*) station on mm/dd/yy and transmits data to the NOAA GOES satellite, NESDIS ID #XXXXXXXX. (Where XXXXXXXX is the GOES ID for that particular station.) The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at http://cdmo.baruch.sc.edu.
>
> Include the following or similar data collection information:
> The 15 minute Data are collected in the following formats for the **CR1000**:

Averages from 5-second data:
Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts)
Maximum, Minimum, and their times from 5-second data:
Air Temperature (°C), Wind Speed, (m/s), Wind Direction Standard Deviation (degrees) from 5-second data
Totals:
Precipitation (mm), PAR (millimoles/m^2), and Cumulative Precipitation (mm)

5) Site location and character – Describe your NERR site (general) and the research site (specific) associated with each Weather Station. For each weather station include: a) its proximity to SWMP water quality monitoring stations, b) latitude and longitude, c) location/placement information (what is the environment on which it is located (pier, building, dock, etc), how close are any wind blocks, does the tower get shaded or obstructed), d) sensor placement information (where the sensors are located in proximity to the tower, how far off the ground are the sensors located, is it in accordance with CDMO Manual, etc), e) other information. If possible, include your station's elevation from sea level.

6) Data collection period – Specify the exact start and end date and times of data collection for each monitoring site for the year. Note when data collection began initially for your Reserve or sample site(s).

7) Distribution – This section will address data ownership and data liability with the following excerpt from the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program in the metadata.

> NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Also include the following excerpt in the metadata to address how and where the data can be obtained.

> NERR weather data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page http://cdmo.baruch.sc.edu/. Data are available in comma separated format.

8) Associated researchers and projects (link to other products or programs) – Describe briefly other research (data collection) that correlates or enhances the data collected at your weather station. At a minimum, mention the SWMP WQ and NUT data sets.

II. Physical Structure Descriptors

9) Sensor specifications – Include parameter description, units, sensor type, model #, (operating temperature), range of measurement, accuracy, (temperature dependence), (sensitivity), (stability), date of last calibration for each sensor and CR1000 description. ***Ensure that sensor information is accurate for your weather station.***

Parameter: Temperature
Units: Celsius
Sensor type: Platinum resistance temperature detector (PRT)
Model #: HMP45C Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C
Date of Last calibration:

Parameter: Relative Humidity
Units: Percent
Sensor type: Vaisala HUMICAP© 180 capacitive relative humidity sensor
Model #: HMP45C Temperature and Relative Humidity Probe
Range: 0-100% non-condensing
Accuracy at 20°C: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Date of Last calibration:

Parameter: Barometric Sensor
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-105
Operating Range: Pressure: 600 to 1060 mb; Temperature: -40°C to +60°C;
Humidity: non-condensing
Accuracy: ± 0.5 mb @ 20°C; +/- 2 mb @ 0°C to 40°C; +/- 4 mb @ -20°C to 45°C; +/- 6 mb @ -40°C to 60°C
Stability: ± 0.1 mb per year
Date of Last calibration:

Parameter: Wind speed
Units: meter per second (m/s)
Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene
Model #: R.M. Young 05103 Wind Monitor
Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)
Accuracy: +/- 0.3 m/s
Date of last calibration:

Parameter: Wind direction
Units: degrees
Sensor type: balanced vane, 38 cm turning radius
Model #: R.M. Young 05103 Wind Monitor

Range: 360° mechanical, 355° electrical (5° open)
Accuracy: +/- 3 degrees
Date of last calibration:

Parameter: LI-COR Quantum Sensor
Units: mmoles m-2 (total flux)
Sensor type: High stability silicon photovoltaic detector (blue enhanced)
Model #: LI190SB
Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.15% per °C maximum
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%
Sensitivity: typically 5 µA per 1000 µmoles s-1 m-2
Multiplier: ***List multiplier(s) and date(s) of change***
Date of last calibration:
Date Installed:

Parameter: Precipitation (specify if heated rain gauge)
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TE525
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Date of Last calibration:

The CR1000 has 2 MB of Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM is (4 MB optional upgrade) available for program storage (16K), operating system use, and data storage. Additional storage is available by using a compact flash card in the optional CFM100 Compact Flash Module.
Date CR1000 Installed:

10) Coded variable definitions - List the sampling station, sampling site code, and station code used in the data.

Sampling station:	Sampling site code:	Station code:
Carriage House	CH	wqbchmet

11) QAQC flag definitions – This section details the automated primary and secondary QAQC flag definitions. Include the following excerpt.

> QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is above or below sensor range, or missing. All remaining data are then flagged 0, as passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.
>
> -5 Outside High Sensor Range
> -4 Outside Low Sensor Range
> -3 Data Rejected due to QAQC

-2 Missing Data
-1 Optional SWMP supported parameter
0 Passed Initial QAQC Checks
1 Suspect Data
2 *Open - reserved for later flag*
3 *Open - reserved for later flag*
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

12) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the QAQC flags above. Include the following excerpt.

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the CR1000, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point.

General Errors

GIM	Instrument Malfunction
GIT	Instrument Recording Error, Recovered Telemetry Data
GMC	No Instrument Deployed due to Maintenance/Calibration
GMT	Instrument Maintenance
GPD	Power Down
GPF	Power Failure / Low Battery
GPR	Program Reload
GQR	Data Rejected Due to QA/QC Checks
GSM	See Metadata

Sensor Errors

SIC	Incorrect Calibration Constant, Multiplier or Offset
SNV	Negative Value
SOC	Out of Calibration
SSN	Not a Number / Unknown Value
SSM	Sensor Malfunction
SSR	Sensor Removed

Comments

CAF	Acceptable Calibration/Accuracy Error of Sensor
CDF	Data Appear to Fit Conditions
CRE	Significant Rain Event
CSM	See Metadata
CVT	Possible Vandalism/Tampering

13) Other remarks/notes – Use this section for further documentation of the research data set. You must include information on any data that were marked with a CSM "See Metadata" comment code. You may include the NERRQAQC macro metadata sheets or any other information regarding significant weather events, maintenance activities, etc that may have affected the weather station and data collected. Include the following excerpts:

Data are missing due to equipment or associated specific sensors not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for "not a number" and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Small negative PAR values are within range of the sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the Licor sensor is +/- 2.214 mmoles/m2 over a 15 minute interval.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/- 3%.

Formatting the meteorological metadata

1) After completing the final version of the metadata documentation, select **Save as** under the **File** menu of Microsoft Word.

2) In the **File name** subwindow, type in a new filename for the text file. Name the metadata document with the following filename code that indicates the NERR site, the data type and what months and year the metadata document covers: use the three letter NERR site code, **the three letter data type code (met=meteorological),** the months this metadata covers in two digit numerical code, the two digit year code and an "m" to indicate this is a metadata file. Please use all lowercase when naming your file. *For example, if the metadata filename is named niwmet01-12.03m, it identifies the file as a NIW NERR meteorological metadata that covers the months of January - December of the year 2003.*

3) In the **Save as type** subwindow, select **Word Document (*.doc)**.

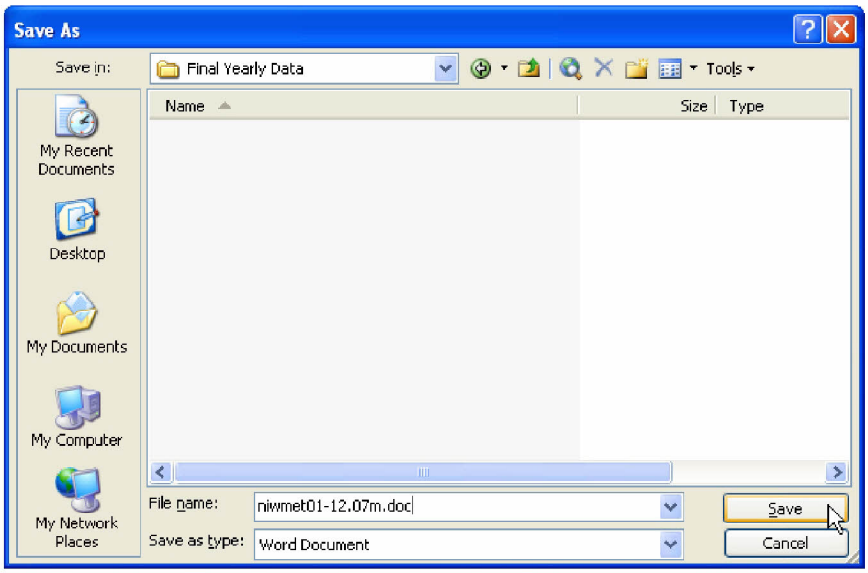


Figure 104. Saving the metadata in Word format.

4) Make sure to select **Binary** in the WS_FTP application before sending to the CDMO.

Meteorological data management: data submission

Submission of final data

Final submission of meteorological data

Reserves must submit the following files to the CDMO by **April 15** of the subsequent year for data submission to be considered complete.

(1) The yearly secondary QAQC'd data files.
(2) The metadata document accompanying the dataset.
(3) The digital monthly logs.

Reserves will upload the yearly secondary QAQC'd data files to the CDMO data submission page at **http://cdmo.baruch.sc.edu/DataUpload/index.cfm** and place the monthly logs and metadata files on the CDMO FTP server (ftp://ftpcdmo.baruch.sc.edu) in the appropriate Reserve's directory.

Summary of steps for handling the meteorological files

1) It is most important to virus check all of the files and metadata before sending it to the CDMO FTP server. See Appendix A for recommended virus protection software.

2) Download the raw **comma delimited format** (**. DAT** or **.CSV**) file from the CR1000 and visually check data with Loggernet.

3) Upload the exported raw **.DAT** or **.CSV** file from Loggernet to the CDMO data submission page for automated primary QAQC.

4) Open the primary QAQC'd file emailed from the CDMO with the **NERRQAQC macro** to conduct secondary QAQC.

5) Enter the station code, graph the data and apply QAQC flags and codes as necessary.

Append secondary QAQC'd files together to create quarterly files.

6) Conduct another review of the appended quarterly files using the NERRQAQC macro, adding QAQC flags and codes as necessary.

7) Export the quarterly secondary QAQC'd files in .**CSV** format and submit the files to the CDMO via the data submission web page (http://cdmo.baruch.sc.edu/DataUpload/index.cfm) for posting as provisional plus data, following the timetable in Table 8.

8) Append the quarterly QAQC'd files together to create one yearly file for each sampling station. Conduct one final review of the data using the **NERRQAQC macro**.

9) Export the final yearly files in **.CSV** format and submit the files to the CDMO via the data submission webpage at **http://cdmo.baruch.sc.edu/DataUpload/index.cfm**. Ensure the CDMO file naming convention is used: three letter **Reserve** code, two letter sampling site code, data type code and four digit year.

10) Complete the final yearly metadata file and submit it to the CDMO FTP server by placing it in the **meteorological/metadata** directory. Ensure the CDMO file naming convention is used: three letter **Reserve** code, the data type code, the months the metadata covers in two digit numerical code, followed by the two digit year code and an "m" to indicate this is a metadata file

11) Submit the completed digital monthly logs to the CDMO FTP server by placing it in the **meteorological/digital logs** directory. Name each file and worksheet as detailed in the "Digital Data Sheets Procedures" document.

The process of data acquisition, primary QAQC, secondary QAQC, metadata documentation and data submission is now complete.

Meteorological data management: data archival

Refer to Chapter 1: Preparation for data management for data backup and archival tips.

It is recommended to backup and archive the following files created during the QAQC process:

(1) Raw **comma delimited format** (**.DAT** or **.CSV**). files from the CR1000

(2) Raw **.DAT or .CSV** files exported from Loggernet

(3) Primary QAQC'd **.CSV/.CDF** files emailed from the CDMO

(4) Secondary QAQC'd **.XLS deployment** workbooks

(5) Quarterly appended QAQC'd **.XLS** workbooks and exported .**CSV** files

(6) Final yearly appended QAQC'd **.XLS** workbook and exported **.CSV** files

(7) Final metadata **.DOC** file

(8) All digital monthly log **.XLS** files

Updating the historical database in EQWin

You can continue to add the final yearly data files to the local historical SWMP database in EQWin. This will serve three purposes:

(1) To backup the data

(2) To keep the local historical database updated

(3) To use EQWin's querying, reporting and exporting tools to satisfy data queries or to use in reports or presentations

If you want to update data to the local historical SWMP data in EQwin, follow these steps and refer to the CDMO NERR SWMP Data Management Manual version 5.2 for detailed instructions on using EQWin software.

1) Open the final appended QAQC'd **.XLS** file in Excel.

2) You will have to split apart the datetimestamp into a date and a time column.

   a. To do this, copy the datetimestamp column, select the next column where you want to copy to and choose **Insert Copied Cells** to copy it. Do this once more so that you will have three datetimestamp columns.

   b. Select the second datetimestamp column and format it as **mm/dd/yyyy** from the **Format Cells** menu. Rename that column **"Date"**.

   c. Select the third datetimestamp column and format it as **hh:mm** from the **Format Cells** menu. Rename that column **"Time"**.

   d. Now delete the first datetimestamp column.

3) Copy the contents of the worksheet.

4) Open the historical EQWin database and paste the data from the altered **.XLS** file into a blank **.EQI** file.

5) Delete the **RowID** column and all flag columns from the **.EQI** file.

6) Configure the **.EQI** file and set field A2 as **First station code**, set field B2 as **Date collected**, set field C2 as **Time collected**, and set field D1 as **First parameter code**.

7) Check the data and update it to the database.

Chapter 8

Weather data review and editing protocol[28]

This document was produced by Jesse Friedmann, NERR CDMO data specialist, and Bob Scarborough, DEL NERR Research Coordinator in 2005. A second revision was completed in 2008.

Introduction

The following document has been prepared to aid users of the Campbell Scientific CR1000 weather station in ascertaining the reliability of the data from its deployment. The primary purpose of the document is to provide guidelines for determining what portions of data records should be included in the overall NERR System-wide Monitoring Program's (SWMP) meteorological station database, and which should be rejected.

This document is clearly not designed to be the final word on the data review and editing issue, but instead to simply be a starting point for consideration, rejection, and modification by the NERR System-wide Monitoring Program as more experience is acquired and more data are generated and processed.

The general philosophy for data acceptance or rejection will be based on absolute and discretionary factors.

(1) **absolute:** In the first phase of data review and editing, values sometimes can be rejected on the basis of absolute factors via software statements with no detailed analysis of the study by the NERR Research Coordinator (RC) or SWMP Meteorological Technician at each site.

(2) **discretionary:** These are other instances in which the data must be examined before absolute rejection. In the second phase we are recommending that each deployment study be evaluated at the site for anomalies prior to submission of data for inclusion in the NERR SWMP's Meteorological Station database.

Absolute Data Rejection criteria

1) Data recorded fell outside range of sensor specifications

Data editing action: Using the appropriate flag (<-3) and code, always reject data that are outside the range and accuracy of the sensor you are using (for example, any Air Temp. recorded that is less than -40 deg. Celsius or greater than 60 deg. Celsius should be rejected).

Sensor ranges for each parameter (*Ensure that sensor information is accurate for your weather station*):

[28] Produced by Jesse Friedmann, NERR CDMO data specialist, and Bob Scarborough of DEL NERR in 2005.

Temperature:
Model #: HMP45C Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C

Model #: HMP35C Temperature and Relative Humidity Probe
Operating Temperature: -35°C to +60°C
Range: -35°C to +55°C
Accuracy: +/- 0.4 °C over -24°C to 48°C; +/- 0.9°C over -38°C to 53°C

Relative Humidity:
Model #: HMP45C Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: 0-100% non-condensing
Accuracy at 20°C: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C

Model #: HMP35C Temperature and Relative Humidity Probe
Operating Temperature: -35°C to +60°C
Range: 0-100% non-condensing
Accuracy at 20°C: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.04% RH/°C

Barometric Pressure:
Model#: Viasala CS-105
Operating Temperature: -40°C to +60°C
Pressure Range: 600 to 1060 mb
Accuracy: ± 0.5 mb @ 20°C; +/- 2 mb @ 0°C to 40°C; +/- 4 mb @ -20°C to 45°C; +/- 6 mb @ -40°C to 60°C

Wind speed:
Model: RM Young 3001 Wind Monitor
Range: 0 to 50 m/s (112 mph); gust survival 60 m/s (134 mph)
Accuracy: +/-0.5 m/s

Model: RM Young 05103 Wind Monitor
Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph
Accuracy: +/- 0.3 m/s

Wind direction:
Model: RM Young 3001 Wind Monitor
Range: 360° mechanical, 355° electrical (5° open)
Accuracy: +/- 5%

Model RM Young 05103 Wind Monitor
Range: 360° mechanical, 355° electrical (5° open)
Accuracy: +/- 3%

PAR:
Model # LI-190SB LI-COR Quantum Sensor

Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.15% per °C maximum
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%

Precipitation:
Model #: Tipping bucket rain gauge TE525
Operating range: Temperature: 0° to +/- 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr

Exception to the rule: The PAR, RH and Wind Direction sensors may sometimes record data outside of sensor range in nighttime conditions, and heavy rainfall conditions or if the wind blew in the 355-0 degree direction. Therefore data for these parameters can be accepted within the accuracy of the sensor. In this case you can flag the data as suspect <1> and comment as acceptable calibration/accuracy error of sensor [CAF] and document those values in the metadata with statements such as:

PAR
Negative PAR data have been observed during the night; small negative values are within range of the sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The maximum signal noise error for the PAR sensor is +/- 2.214 mmoles/m2 over a 15 minute interval.

RH
Relative Humidity data greater than 100% or less than 0% have been observed; these data are within range of the sensor accuracy of +/-2 to -3%.

Wind Dir.
The Wind Direction sensor may output slightly negative numbers when the wind direction is in the 5 degree deadband zone (355-0 degrees). The resulting negative value can be interpreted as 0 degrees.

2) Inaccurate data due to power down or program reload

If you need to power down the weather station or reload a program it is always a good idea to download the data before doing so to ensure no data are lost.

Data editing action: During these events all 15 minute data must be rejected, using the Data rejected flag <-3> and the Power down code [GPD] or Program reload code [GPR], from the time the event starts until the event ends.

One important note, whenever a new program is uploaded all existing data may be lost. Always download all data before entering new programs or turning off the unit to prevent accidental data loss. In addition if the CR1000 is powered down for sensor replacement or any other reason all of the data used to calculate the 15 minute data are lost for that time interval. This means that if the unit was powered down at 0921 on January 5th, the 0930 15 minute data must be rejected.

3) No sensor installed

If a sensor is not connected to the CR1000 then output values may be recorded as erroneous values or **NAN**'s (not a number).

Data editing action: Reject any erroneous values that fall outside of sensor range. **Please note: NAN's can also be recorded due to sensor malfunctions and will need to be documented as such if it is known that the sensor was connected. .**

Discretionary Data Rejection criteria:

In this part of the procedure, data analysis of all recorded parameters should be carried out by or under the supervision of the site Research Coordinator. If anomalies are observed, that data may be marked as an anomaly using the Suspect Data flag <1> , or rejected using the Data Rejection flag <-3> at the discretion of the Research Coordinator.

All Data

Sensor malfunctions or failures may be indicated by the occurrence of NAN's and some sensors have default values that will be output when sensor errors occur. Most of the time, discretionary data rejections will fall into one or more of the following categories; however that is not to say that there may not be other causes for rejecting data:

- Incorrect or loose wire connections
- Calibrations are out of date
- Calibration constants are incorrect
- Wrong multipliers used in program
- Low battery

Temperature

When the temperature sensor fails due to loose wire connections, the output values will sometimes be very noticeable as in NAN's or very high/low values. However the signs of sensor failure or malfunction may not always be that clear. Therefore, the things to look for would be a discontinuity in the temperature readings or sharp jumps over the 15 minute periods. The best way to notice most sensor failures would be to graph the data. **Please also be aware that Relative Humidity is temperature dependent and it is always good practice to double check the RH readings when you suspect temperature sensor failure!**

Example data:

Date	Time	ATemp	RH	MaxRH	MaxRHT	MinRH
07/19/2007	13:30	**25.0**	089	**090**	1326	**088**
07/19/2007	13:45	**15.3**	087	**235**	1343	**034**

In this example you can see that the average temperature dropped 10 degrees Celsius in 15 minutes, and although the average Relative Humidity looked normal the Maximum and Minimum RH values did not! (In this particular case the temperature sensor did fail as the next reading at 14:00 was
NAN).

If the point of discontinuity is clear and you suspect sensor failure/malfunction you would then decide to either flag the data as suspect <1> or reject <-3> the data and code appropriately.

Relative Humidity

If the relative humidity sensor fails you may have values of NAN recorded, however there may be evidence of this failure before the onset of the NAN values. You should be looking for discontinuity within the data values, sometimes a sharp jump or a gradual drift. Many times the sensor failure will be caused by condensation forming on the sensor itself resulting in bad data values.

Date	Time	**RH**	**MaxRH**	Max RHT	MinRH	MinRHT
9/17/2007	21:15	**103**	**173**	2113	99	2114
9/17/2007	21:30	**114**	**142**	2118	96	2118
9/17/2007	21:45	**111**	**148**	2142	99	2142
9/17/2007	22:00	**110**	**207**	2157	101	2145
9/17/2007	22:15	**116**	**202**	2200	94	2208
9/17/2007	22:30	**109**	**122**	2227	100	2218
9/17/2007	22:45	**117**	**166**	2240	101	2241

Example data: The RH values in bold were recorded before the sporadic recordings of NAN indicating sensor failure.

Barometric Pressure

With the failure/malfunction of the Barometric Pressure (BP) sensor an output value of approximately 600 mb will be recorded. This is most likely caused when the little black jumper is not in place or there is a loose connection. You may also see NAN's indicating a sensor malfunction. The ~600 mb values should be rejected. Normal ranges for the BP sensor tend to fall between **880 mb** and **1040 mb**. Anything outside of this range should be further investigated and checked against ancillary data or by using other external sources such as a Kestrel hand held unit.

Example data: these data values were caused by a bad sensor.

Date	Time	BP	MaxBP	MaxBPT	MinBP	MinBPT
01/07/2007	12:45	**NAN**	**0626**	1055	**NAN**	1240
01/07/2007	13:00	**0582**	**0585**	1245	**0582**	1249
01/07/2007	13:00	**NAN**	**0626**	1055	**NAN**	1240
01/07/2007	13:15	**0582**	**0582**	1300	**0581**	1314
01/07/2007	13:30	**0581**	**0583**	1329	**0581**	1316
01/07/2007	13:45	**0585**	**0588**	1344	**0583**	1330
01/07/2007	14:00	**0593**	**0598**	1400	**0589**	1345
01/07/2007	14:00	**0585**	**0598**	1400	**0581**	1316
01/07/2007	14:15	**0602**	**0606**	1415	**0598**	1400
01/07/2007	14:30	**0608**	**0610**	1429	**0606**	1415
01/07/2007	14:45	**0611**	**0612**	1439	**0610**	1430

Photosynthetic Active Radiation (PAR)

The value most noticed when a sensor fails or malfunctions would be the NAN value, but another value that would indicate a problem with the PAR sensor is 99999. This is the maximum value of PAR that indicates that the calibration number is incorrect and needs to be corrected. Also values that may not be so clear are very high PAR values indicating a wrong multiplier was used to calculate this value. Normal ranges for 15 minute PAR values fall between **0** and **1800 mmoles/m^2.**

Wind Direction/Wind Speed

At times the wind speed anemometer may get stuck and stop. When this happens the data may continuously record zero as the wind speed. If this occurs you can decide to either retain the data and document the event or reject the data altogether. The wind direction sensor, as mentioned above, will sometimes output small negative values in the 5 degree dead band zone (355-0). **It is important to check the orientation of the wind sensor periodically to ensure it is always pointing True North, since this may result in inaccurate readings.**

Example data: both sensors were wired incorrectly

Date	Time	**WSpd**	**Wdir**
02/02/2007	17:15	**00.0**	**000**
02/02/2007	17:30	**00.0**	**000**
02/02/2007	17:45	**00.0**	**000**
02/02/2007	18:00	**00.0**	**000**
02/02/2007	18:00	**00.0**	**000**
02/02/2007	18:15	**00.0**	**000**
02/02/2007	18:30	**00.0**	**000**
02/02/2007	18:45	**00.0**	**000**
02/02/2007	19:00	**00.0**	**000**
02/02/2007	19:00	**00.0**	**000**
02/02/2007	19:15	**00.0**	**000**
02/02/2007	19:30	**00.0**	**000**
02/02/2007	19:45	**00.0**	**000**
02/02/2007	20:00	**00.0**	**000**
02/02/2007	20:00	**00.0**	**000**
02/02/2007	20:15	**00.0**	**000**
02/02/2007	20:30	**00.0**	**000**
02/02/2007	20:45	**00.0**	**000**
02/02/2007	21:00	**00.0**	**000**
02/02/2007	21:00	**00.0**	**000**

Precipitation

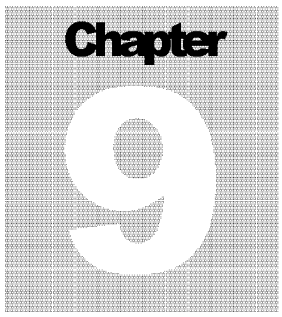
The tipping bucket rain gauges are ideal sites for roosting and eating for birds and other animals which makes this sensor highly prone to errors. If the bucket gets clogged with debris then your total rainfall may be inaccurate or time span of the rainfall will be longer. If the bucket gets stuck in the tipped position your values will also be inaccurate. That is why it is always a good idea to check the rainfall in the area from another data source so you can be sure that the precipitation collected is accurate. In addition, the gauge should be checked often for debris (preferably weekly). If the bucket malfunctions or

fails then zeros will be recorded when rain actually fell. You may flag inaccurate rainfall values as anomalous <1> or rejected <-3>.

Other Data Rejection Instances

Battery Failure: If there is a skip in the data from one day to the next the likely cause is battery failure. The battery will fail after it drops **below 9.6 volts and the CR1000 will shut down.** Battery voltage normally should be greater than 11.0 volts and never more than 16.0 volts. If you have battery values below 9.6 or greater than 16 recorded and your CR1000 did not shut down, most likely there is a problem with the collection of the battery volt data. Therefore the battery data should be rejected and the rest of the data double checked for accuracy. Any NAN data should remain in the data. Flag any missing data due to battery failure.

Data Overwriting: If there is a skip in the data anywhere from a small amount missing to an entire day or if the first line of data in the file is unrecognizable, the cause may be due to a memory overwrite (unlikely if downloading data monthly). This is most likely because the data are not downloaded frequently enough. If this happens, flag any missing data <-2> and be sure to reject <-3> the data and reject all 15 minute data affected by the overwrite.



Standard Operating Procedures: Nutrient Monitoring

(INSERT NUTRIENT AND CHLOROPHYLL MONITORING PROGRAM SOP HERE)

Chapter 10

Nutrient Data Management Procedures

The Nutrient Data Management Procedures chapter describes the collection, error checking, review, editing, graphing and export of the data as well as creation of the associated metadata.

Overview of data management

Once data have been acquired from the analytical laboratory and validated, Reserves will use the tools developed by the CDMO to conduct secondary QAQC. Reserves may choose to compile a full year of data before beginning secondary QAQC, which is the most straightforward method, or process data as it is acquired by either using and appending multiple workbooks or appending data within the same workbook. Both of the latter methods require additional processing steps which will be detailed in the secondary QAQC component of this document. Nutrient data will be submitted to the CDMO on an annual basis. There is currently no upload tool for nutrient data; it must be posted to the CDMO ftp site (ftp://cdmo.baruch.sc.edu/) for submission. After submission of the final yearly data, raw data, and all supporting documentation, the CDMO will perform tertiary QAQC. Once the data have been authenticated, the data will be posted as authoritative[29] on the CDMO ODIS.

Data submission timelines

Yearly secondary QAQC'd files must be submitted to CDMO for final review by May 15 of the following year. The compiled yearly data files, yearly metadata file and raw data will be included in this submission.

Notify the CDMO of your yearly secondary QAQC'd data submissions. This will enable us to verify that your submission is complete *before* the deadline.

Overview of data collection

The nutrient and chlorophyll monitoring program began in January 2002. Grab samples are collected either in duplicate every month from all four long-term monitoring locations at each NERR or single grab samples may be substituted for replicates IF triplicate grab samples are collected at least every other month at a randomly chosen long-term monitoring station AND sampling protocol at the NERR does not call for sampling at multiple depths (above and below the thermo/chemocline). At least 11 diel samples are collected at equal time intervals, over one full tidal cycle or 24 hours (whichever is greater), every month at one of the long-term monitoring locations at each NERR. The diel sampling location may be rotated to other SWMP stations

[29] Authoritative data refer to data that have gone through final tertiary review at the CDMO.

to increase spatial coverage, but must remain in place at least one year before moving[30]. All samples are analyzed for the following required Tier I parameters: orthophosphate (PO_4^-), chlorophyll a_(CHLA), ammonium (NH_4^+), nitrate (NO_3^-), and nitrite (NO_2^-). If a Reserve can show that (NO_2^-) is a minor component relative to (NO_3^-), nitrate+nitrite (NO23) may be substituted for (NO_2^-) and (NO_3^-). Collection and submission of additional Tier II parameters is encouraged.

For the nutrient data, the following units and format should be used:

Parameter	Short Name	Units	Format
(1) Station code[31]	**(same)**	**n/a**	**three letter reserve code, two letter sampling station code, nut data type code**
(2) DateTimeStamp	**(same)**	**mm/dd/yyyy hh:mm**	**mm/dd/yyyy hh:mm**
(3) Monitoring Program[32]	**(same)**	**n/a**	**1, 2**
(4) Replicate number[33]	**Rep**	**n/a**	**1, 2, 3 or S**
(5) Orthophosphate	**PO4F**	**mg/L**	**0.000**
(6) Ammonium	**NH4F**	**mg/L**	**0.000**
(7) Nitrite	**NO2F**	**mg/L**	**0.000**
(8) Nitrate	**NO3F**	**mg/L**	**0.000**
(9) Nitrite+Nitrate	**NO23F**	**mg/L**	**0.000**
(10) Chlorophyll	**CHLA_N**	**µg/L**	**0.0 or 0.00**

IMPORTANT: The data parameters are no longer required to be listed in a specific order; however, we do require that parameters are grouped by nutrient/pigment within the data sheet. For instance, arrange your nitrogen parameters (NH4F, NO2F, NO3F, NO23F, etc) and their associated flag columns so that they are adjacent in the datasheet. Grouping these parameters within the datasheet aids in both the secondary and tertiary QAQC process.

[30] Diel samples must be collected at the same station for at least one year before a change can be made and any change must be documented in the metadata.
[31] The CDMO requires all data to include the station code (three letter Reserve code, two letter sampling station code and data type code) in order to properly identify each data record.
[32] Use 1 to indicate the monthly grab sampling program and 2 to indicate the monthly diel sampling program.
[33] Use 1, 2 or 3 to indicate the sample replicate number. If a diel and grab sample occur at the same station, date, and time, use S for the grab sample class.

Nutrient data review and editing tips

1) **Always archive the data**. Keep copies of the data on other computers, on CD and on other hard drives. Backup and archive on a regular basis to ensure there will be no data loss. Third party software can be purchased to accomplish this. Archive the **raw data files** as they are retrieved.

2) **Always record in local Standard Time NOT Daylight Savings Time**. Set the clocks on your instruments and the computers that interface with them to Standard Time and DO NOT adjust them to Daylight Savings. Try to get in the habit of recording the time off your watch in Standard Time as well.

3) **No data values are to be removed from the dataset under any conditions, except for the removal of any -9999s or other symbols (*) that may have taken the place of below MDL values.** If your below MDL values are recorded with a less than sign (ex: <0.0002), the macro will remove them for you.

4) Erroneous or suspect data are not always obvious when viewing a dataset. Use a combination of graphs, statistics, and your field and lab notes to thoroughly investigate the data.

Nutrient data management: overview

Nutrient data management consists of the following components:

(1) **Data acquisition** from the analytical laboratory and conversion to required units.

(2) Primary QAQC (validation) of the data file.

(3) **Secondary QAQC** of the data file with the **NutrientQAQC.XLS** Excel macro, developed by the CDMO to:

a. Allow the user to enter nutrient data into the workbook
b. Apply rounding rules and set significant digits
c. Automatically flag below MDL values based on user input
d. Set up, calculate, and automatically flag calculated parameters for component parameters below MDL, missing components, or negative values
e. Allow the user to view trends in the data with graphing tools and summary statistics
f. Allow the user to document the data by applying QAQC flags and codes
g. Allow the user to export the data in comma delimited format

(4) **Metadata documentation** to accompany the dataset.

(5) **Data submission** to the CDMO for tertiary QAQC. Data are posted as authoritative after tertiary QAQC and authentication by the CDMO.

(6) **Data archival** onto CD, DVD, a separate computer or hard drive, or to the local network and archival of data into EQWin (optional).

Each component will be discussed in this chapter.

Nutrient data management: data acquisition

In order to report nutrient data in a consistent format, data must be reported in the units specified by the National Estuarine Research Reserve Nutrient and Chlorophyll Monitoring Program and Database Design SOP (NERR Nutrient SOP) in Table 2, "Parameter Titles and Variable Names by Data Category." The NERR Nutrient SOP can be found in Chapter 9 of this document. If your analytical laboratory reports the data in different units, you must convert to the proper units. Follow the instructions below for the most common conversion used by Reserves. Contact your laboratory with any questions regarding their data reporting protocols.

Conversion of raw data to accepted units

The NERR Nutrient SOP requires that all Phosphorus, Nitrogen, Silica, and Carbon parameters be reported in milligrams per Liter (mg/L) as N, P, Si, or C respectively. Analytical laboratories often report nutrient concentrations in micromolar (µM, or micromoles/L) units as an alternative. Conversion into the proper units must be completed before beginning secondary QAQC with the NutrientQAQC macro. This task should be completed in a separate Excel worksheet(s) created for this purpose and archived to document this important process step.

In order to convert from µM to mg/L as N, P, Si, or C you must account for the atomic weight of the element. The following atomic weights are generally accepted (with four significant figures):

Atomic weights are in g/mol
microMolar (µM) = micromoles/Liter

N = 14.01 g/mol

P = 30.97 g/mol

Si = 28.09 g/mol

C = 12.01 g/mol

To convert Nitrogen from g/mol to mg/L:

14.01 g/mol = 14010.0 mg/mol

14010.0 mg/mol = 0.014010 mg/micromole

0.014010 mg/micromole * X in micromoles/Liter → mg/L as N

With this in mind the correct conversion factors for µM to mg/L as each element are 0.01401, 0.03097, 0.02809, and 0.01201 respectively. See the following examples:

NH4 µM * 0.01401 → mg/L as N (use this same conversion factor for NO2, NO3, NO23, etc)

1.61668 µM * 0.01401 → 0.02265 mg/L as N

PO4 µM * 0.03097 → mg/L as P

2.06084 µM * 0.03097 → 0.06382 mg/L as P

SiO4 µM * 0.02809 → mg/L as Si

70.26800 µM * 0.02809 → 1.97383 mg/L as Si

DOC µM * 0.01201 → mg/L as C

294.8959 µM * 0.01201 → 3.5417 mg/L as C

Note that the converted values in the examples above have not been truncated to the correct number of significant digits. This step will be completed during secondary QAQC using the Nutrient QAQC macro.

Nutrient data management: primary QAQC

During primary QAQC, Reserves will validate the nutrient data received from the analytical laboratory.

Data validation

Data validation is an important part of the primary QAQC process, despite the fact that Reserves receive nutrient data in different formats and therefore there is no single protocol for this step. All Reserves should validate data received from the lab, either in digital or hardcopy format, by verifying sample IDs, dates, and parameters with their records. If there is a discrepancy, finding it early may allow for data recovery or clarification from the lab. Data that are input manually should always be authenticated by a second person. Any data manipulation, including copying and pasting into worksheets and unit conversions, should be validated and the process documented in the metadata.

Primary QAQC flags

There are eleven QAQC flags ranging from -5 to 5. Because the raw nutrient data will not be uploaded to the CDMO or go through automated primary QAQC, the following flags will be applied during the secondary QAQC process.

-2 **Missing data:** Used during secondary QAQC where a value is missing (not collected).

-1 **Optional SWMP supported parameter**: Applied during secondary QAQC where an optional parameter was not reported for all samples.

0 **Data passed initial QAQC checks:** Applied to all remaining data without a QAQC flag during tertiary QAQC at the CDMO.

4 **Historical: Pre-automated QAQC:** Used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in data from 2006 and earlier that are exported from the CDMO ODIS.

Nutrient data management: secondary QAQC

During secondary QAQC at the Reserve, QAQC flags and codes are inserted directly into the dataset with the NutrientQAQC macro and used to provide data documentation. These flags and codes become metadata for the data, thereby dramatically reducing the amount of documentation required in the traditional metadata document.

Secondary QAQC flags

-3 **Rejected data:** Used during secondary QAQC to indicate a rejected value. **No data values are to be removed from the dataset under any conditions** except for the removal of any symbols (*) or -9999 values that may have replaced below MDL values.

1 **Suspect data:** Used during secondary QAQC to indicate a suspect value.

5 **Corrected data:** Used during secondary QAQC to indicate a value that has been corrected or changed.

When to use QAQC flags

Secondary QAQC flags must be applied to any data considered to be suspect, that should be rejected, or that have been corrected. **Only one QAQC flag is allowed per value.**

Secondary QAQC codes

QAQC codes are used during secondary QAQC to allow for further documentation of the data. QAQC codes fall into three categories:

1) **General errors:** Used to document general problems with the sample or sample collection. Cannot be used in combination with a sensor error code.

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks

2) **Sensor errors:** Used to document common sensor or parameter specific problems. Cannot be used in combination with a general error code.

SBL	Value below minimum limit of method detection[34]
SCB	Value calculated with a value that is below the MDL
SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

[34] The SBL code will automatically be applied by the Nutrient QAQC macro after MDLs are entered, but may also be applied manually for Reserves that don't receive values that are below MDL from their labs.

3) **Comments:** There are two different types of comment codes available for use with the nutrient data.

Parameter Comments: Can be used alone or in combination with a general error or sensor error code to further document conditions or a problem with the data. These codes may be applied to a specific parameter.

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments: Can only be applied to entire records in the record flag column to describe conditions during sample collection. These comments are not used in conjunction with flags and an unlimited number of comment codes can be applied to the same record.

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample
Cloud cover	
CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)
Precipitation	
PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow
Tide stage	
TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide
Wave height	
WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters

WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters
Wind direction	
N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest
Wind speed	
WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

The QAQC codes available for use during secondary QAQC are accessible from the **Apply Flag Codes** tool within the NutrientQAQC macro. These codes cover the most common problems encountered with the NERR SWMP data. The "CSM" see metadata comment code can be applied to address additional problems that do not have a specific QAQC codes, or that require a more detailed explanation, and are further documented in the Microsoft Word metadata document that will accompany the dataset. To request additional codes, contact the CDMO data management team at cdmo@belle.baruch.sc.edu. If the majority of the NERR community is in agreement, we will include them in the next release of the NutrientQAQC macro.

When to use QAQC codes

A QAQC code must be applied to any data flagged as -3, 1, or 5.

A QAQC code is not required, but may be included, for any data flagged -2.

A maximum of two QAQC codes are allowed per parameter value. A general error code cannot be used in combination with a sensor error code and vice versa. You must choose the most appropriate general or sensor error to use when documenting a value. A parameter comment code can be used in addition to a general error or sensor error code.

An unlimited number of QAQC record comment codes are allowed per record.

Considerations before conducting secondary QAQC

Be sure to have the most up to date version of the NutrientQAQC macro.

No data values are to be removed from the dataset under any conditions, except for the removal of -9999 values or other symbols (*) that may have replaced below MDL values. The macro will remove below MDL values preceded by a "<" during MDL processing. The use of QAQC flags will indicate that a value has been flagged as suspect, rejected or if the value has been corrected.

Tier II parameters can be included for submission to the CDMO. The CDMO encourages the submission of non-required Tier II parameters. If there is a parameter that you measure and would like to include in your submission, but is not currently listed in the Nutrient SOP or supported by the CDMO NutrientQAQC macro, please contact the CDMO team at cdmo@belle.baruch.sc.edu.

You will need to periodically save the Excel data workbook because it is the working QAQC file. Saving the file as an Excel workbook will allow you to continue QAQC on the file at any time and preserve a record of the MDL worksheet and any charts that have been created.

Overview of the NutrientQAQC macro

The NutrientQAQC macro will allow you to perform the following tasks:

Step 1: Create Data Sheets

a. Automatically create the data, MDL and metadata worksheets.

Step 2: Data Sheet Setup

a. Select the parameters to report and automatically add flag columns and column headers.

Step 3: Enter Data

a. Validate data entry.

Step 4: Set Significant Digits

b. Set the number of significant digits to report each parameter to.

c. Automatically apply banker's rounding rules that determine when to drop a .5 or round up to the next even number.

Step 5: Enter MDL information

d. Enter the MDL for each measured parameter.

e. Automatically flag values below the MDL.

Step 6: Set Up Calculated Parameters

a. Select desired calculated parameters from those available based on measured parameters reported.

b. Automatically calculate selected parameters.

c. Automatically flag negative calculated values and their components, values calculated with a component below MDL, and values calculated with a missing component.

Step 7: Create Charts

a. Automatically generate a chart for any parameter.

Step 8: Apply Flag Codes

a. Insert QAQC flags and codes into the flag columns of the dataset.

b. Undo any flagging if necessary.

Step 9: Synchronize Metadata Sheets

a. Synchronize flagged data between the data and metadata sheets and updates summary statistics to facilitate QAQC and metadata documentation.

Step 10: Save as Excel File

a. Save the workbook as an Excel file.

Step 11: Export CSV File

a. Export the final QAQC'd file in **.CSV** (comma delimited) format.

Run Statistics:

a. Creates statistics metadata worksheet and calculates min, max, average and standard deviation for each parameter.

Step 1: Create Data Sheets

There are three ways to conduct secondary QAQC on the nutrient data listed in order of difficulty:

(1) Conduct secondary QAQC only when an entire year of data have been acquired from the analytical laboratory. This is by far the simplest method and does not preclude entering data into the datasheet as it is received.

(2) Create a new workbook for each batch of data received from the laboratory to conduct secondary QAQC on. Once a year of data have been acquired, manually append the exported files together to create one yearly file to perform a final review of before submission to the CDMO. You will have to copy the MDL sheet from each workbook into the final yearly workbook for submission to the CDMO.

(3) Conduct QAQC on first batch of data received from the lab, and then manually append data as it is received from the lab. Using this method will mean that MDL's have to be reprocessed and significant figures reset for every measured parameter, and then calculated parameters regenerated and their significant figures reset every time new data are appended to the file.

Use the **Create Data Sheets** tool to create a workbook to enter the nutrient data into.

1) Click on the **Nutrient QAQC Main Menu** button in the Excel toolbar.

Figure 105. Nutrient QAQC toolbar

2) The **Nutrient QAQC Main Menu** window will open allowing you to launch each step of the macro for data processing.

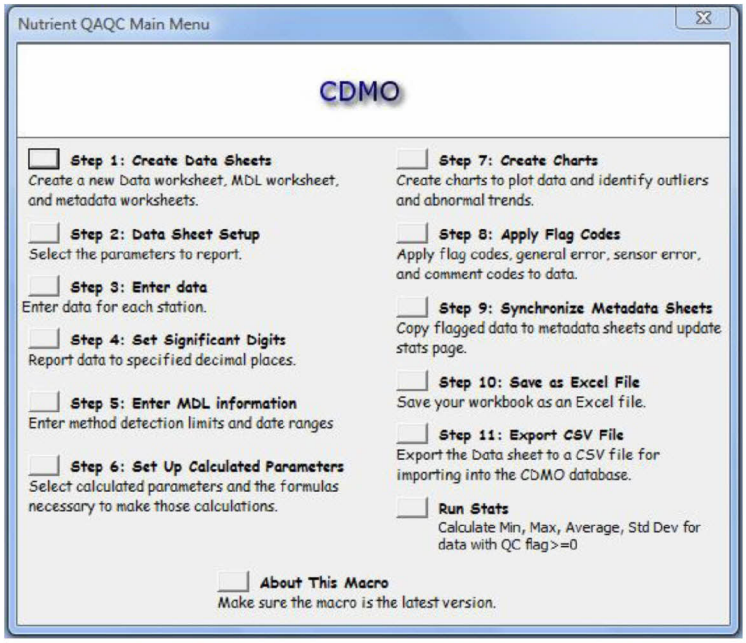


Figure 106. Nutrient QAQC main menu

3) Click on the **Step 1: Create Data Sheets** button and a window will appear. Click on the **Create Data Sheets** button and a new nutrient workbook will be created.

Figure 107. Create worksheets window

4) The workbook will contain a "Data" worksheet where the data will be input, an "MDL" worksheet where the MDL information will be stored, a "User Notes" worksheet, and metadata worksheets for each data flag.

	A	B	C	D	E	F	G	H	I	J
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record					
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Data | MDL | User Notes | Rejected Data <-3> | Missing Data <-2> | Passed Initial QAQC Checks <0>

Figure 108. Data sheet

5) The following window will appear once the workbook has been created.

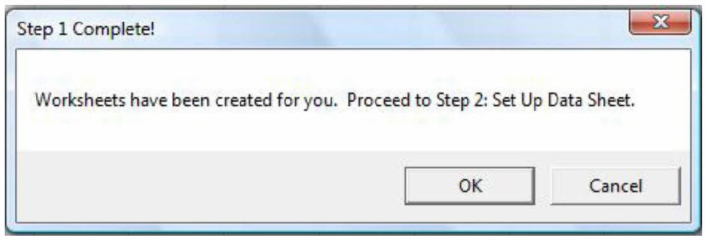


Figure 109. Step 1 complete window

6) Click **OK** to proceed to **Step 2: Data Sheet Setup**.

Step 2: Data Sheet Setup

The **Data Sheet Setup** tool will allow the user to select the measured parameters to report.

1) Once the workbook as been created with the **Create Data Sheets** tool, the **Data Sheet Setup** tool will automatically launch. You will be prompted to select the measured parameters to be reported from the following window.

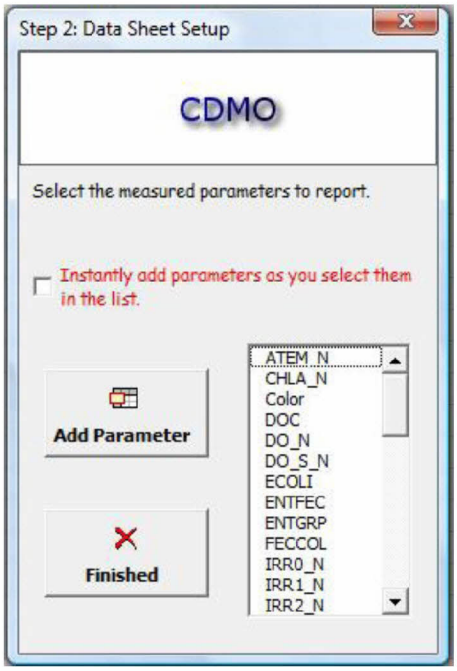


Figure 110. Enter measured parameters

2) The list of parameters in the scroll box includes all measured parameters listed in Table 2 of the Nutrient SOP, except for the condition descriptors which are available as QAQC record comment codes in **Step 8: Apply Flag Codes**.

3) Select the first measured nutrient or pigment parameter to be reported from the list, then click the **Add Parameter** button. ***Do not add any field parameters such as Water Temp, Air Temp or Wind Direction at this time.***

a. As each parameter is added to the data sheet, flag columns are also inserted and given a header preceded by a F_.

4) Repeat this for each parameter you include. If you wish to skip the step of clicking the **Add Parameter** button, check the **Instantly add parameters as you select them in the list** check box. Select the **Finished** button to continue.

a. As you add parameters to the data sheet, those parameters will no longer be available in the list.

b. If you add a parameter that you do not measure, you can delete it from the data sheet.

c. Change your parameter order by simply cutting and pasting or inserting column headers into their appropriate place. Do this in order to group your parameters by nutrient or pigment type.

IMPORTANT: The parameters no longer have to be arranged in a specific order in the data sheet, however, parameters must be grouped by nutrient/pigment when submitted to the CDMO.

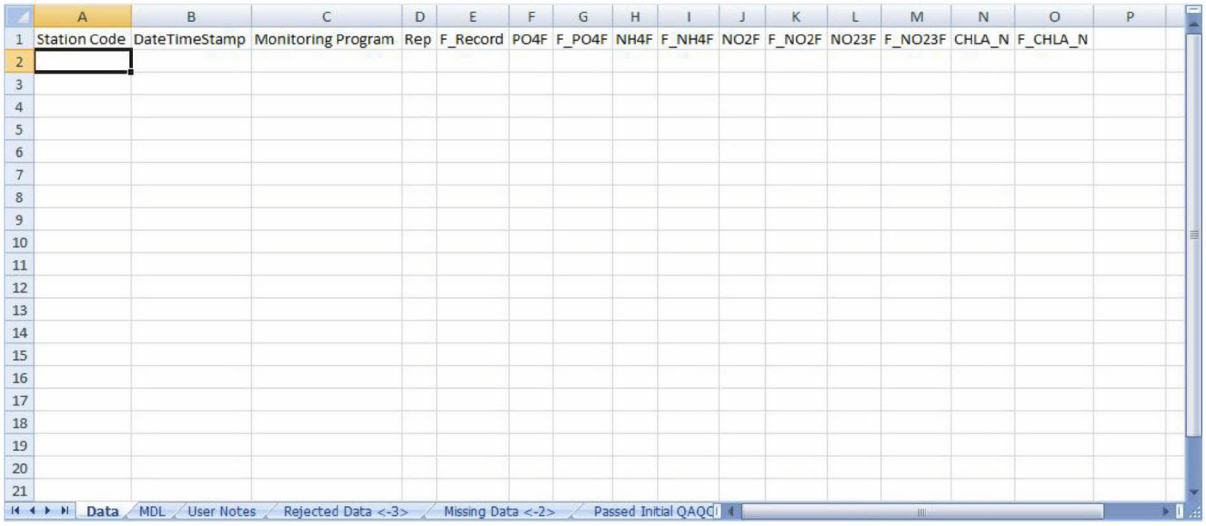


Figure . Nutrient template.

5) Click **Finished** to proceed to **Step 3: Enter Data**.

Step 3: Enter Data

1) Once the data sheets have been set up, the **Nutrient QAQC Main Menu** will reappear. Click on the **Step 3: Enter Data** button.

2) Retrieve the results from the analytical laboratory and enter the data into the "Data" sheet.

   a. If the data were received electronically in spreadsheet format from the lab, simply copy and paste the data into the data sheet in the appropriate columns.

   b. If the data were received on hardcopy, the data will need to be manually entered into the data sheet.

3) **It is important to validate your data entry at this time to ensure no errors are introduced into the dataset.**

4) Enter the station code for every record into the station code column. This will ensure that each record is identified with the proper sampling station code. The station code conforms to the following naming convention: **the three letter NERR site ID, the two letter sampling station ID and the three letter data type (nut)**.

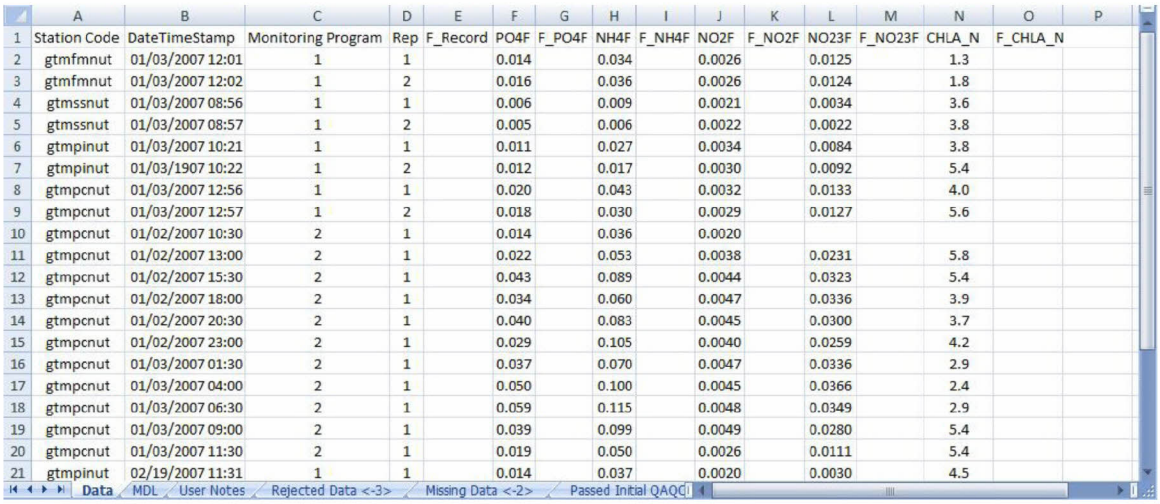
5) Ensure that the date and time are entered in the mm/dd/yyyy hh:mm (no seconds) format. The DateTimeStamp column has been pre-formatted for you. **Note that date and time must be combined into a date/time stamp. This will ensure proper graphing in Excel.**

6) Enter a 1 in the monitoring program column to denote the monthly grab sampling program and a 2 to denote the monthly diel sampling program.

7) Enter a 1 in the replicate (Rep) column to denote the first sample, 2 to denote the second, and 3 to denote the third sample. **Note:** If a diel and a grab sample were taken at the same station at the same date and time, denote the grab sample replicate with an S to indicate that the sample was taken on the same date and time and from the same station as the diel sample. If two samples (grab or diel) occur at the same station, date, and time due to sample splitting in the lab, the time of the second sample will need to be changed (minutes only). This will ensure consistency with historical data as well as allow you to update the historical EQWin databases if you desire.

8) The **F_Record** column will allow the Reserve to further document each record of the dataset by inserting QAQC comment codes to supply information about the sample and for cloud cover, precipitation type, tidal stage, wave height, wind direction and wind speed conditions at sample collection. These codes will be applied during the apply flags process.

9) Once all the measured nutrient or pigment data have been entered, the data sheet should resemble the following example.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record	PO4F	F_PO4F	NH4F	F_NH4F	NO2F	F_NO2F	NO23F	F_NO23F	CHLA_N	F_CHLA_N	
2	gtmfmnut	01/03/2007 12:01	1	1		0.014		0.034		0.0026		0.0125		1.3		
3	gtmfmnut	01/03/2007 12:02	1	2		0.016		0.036		0.0026		0.0124		1.8		
4	gtmssnut	01/03/2007 08:56	1	1		0.006		0.009		0.0021		0.0034		3.6		
5	gtmssnut	01/03/2007 08:57	1	2		0.005		0.006		0.0022		0.0022		3.8		
6	gtmpinut	01/03/2007 10:21	1	1		0.011		0.027		0.0034		0.0084		3.8		
7	gtmpinut	01/03/1907 10:22	1	2		0.012		0.017		0.0030		0.0092		5.4		
8	gtmpcnut	01/03/2007 12:56	1	1		0.020		0.043		0.0032		0.0133		4.0		
9	gtmpcnut	01/03/2007 12:57	1	2		0.018		0.030		0.0029		0.0127		5.6		
10	gtmpcnut	01/02/2007 10:30	2	1		0.014		0.036		0.0020						
11	gtmpcnut	01/02/2007 13:00	2	1		0.022		0.053		0.0038		0.0231		5.8		
12	gtmpcnut	01/02/2007 15:30	2	1		0.043		0.089		0.0044		0.0323		5.4		
13	gtmpcnut	01/02/2007 18:00	2	1		0.034		0.060		0.0047		0.0336		3.9		
14	gtmpcnut	01/02/2007 20:30	2	1		0.040		0.083		0.0045		0.0300		3.7		
15	gtmpcnut	01/02/2007 23:00	2	1		0.029		0.105		0.0040		0.0259		4.2		
16	gtmpcnut	01/03/2007 01:30	2	1		0.037		0.070		0.0047		0.0336		2.9		
17	gtmpcnut	01/03/2007 04:00	2	1		0.050		0.100		0.0045		0.0366		2.4		
18	gtmpcnut	01/03/2007 06:30	2	1		0.059		0.115		0.0048		0.0349		2.9		
19	gtmpcnut	01/03/2007 09:00	2	1		0.039		0.099		0.0049		0.0280		5.4		
20	gtmpcnut	01/03/2007 11:30	2	1		0.019		0.050		0.0026		0.0111		5.4		
21	gtmpinut	02/19/2007 11:31	1	1		0.014		0.037		0.0020		0.0030		4.5		

Data | MDL | User Notes | Rejected Data <-3> | Missing Data <-2> | Passed Initial QAQC

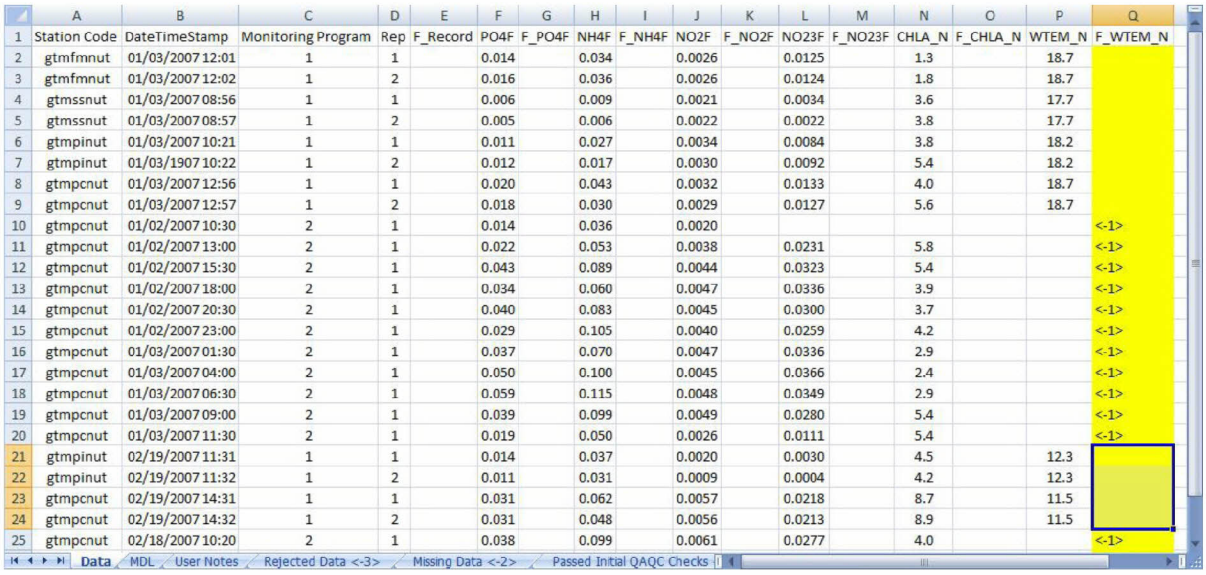
Figure 112. Example nutrient data

10) **Save the Excel workbook!** To do this, jump ahead to **Step 10: Save as Excel file**. Do this periodically while working with the file, **this Excel workbook is the working file that you will QAQC.** Saving the file as an Excel workbook will allow you to continue QAQC on the file at any time as well as preserve a record of all the metadata sheets and the MDL sheet.

11) **If you have field parameters to report,** go back to **Step 2: Data Sheet Setup** and add them at this point.

    a. The Nutrient QAQC macro will automatically insert <-1> flags in the field parameter flag column(s) to ensure that field data that were not collected for all samples (i.e. for diel samples) are flagged properly as optional data, rather than missing data.

    b. Enter your field data and delete the <-1> flag for each sample value.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record	PO4F	F_PO4F	NH4F	F_NH4F	NO2F	F_NO2F	NO23F	F_NO23F	CHLA_N	F_CHLA_N	WTEM_N	F_WTEM_N
2	gtmfmnut	01/03/2007 12:01	1	1		0.014		0.034		0.0026		0.0125		1.3		18.7	
3	gtmfmnut	01/03/2007 12:02	1	2		0.016		0.036		0.0026		0.0124		1.8		18.7	
4	gtmssnut	01/03/2007 08:56	1	1		0.006		0.009		0.0021		0.0034		3.6		17.7	
5	gtmssnut	01/03/2007 08:57	1	2		0.005		0.006		0.0022		0.0022		3.8		17.7	
6	gtmpinut	01/03/2007 10:21	1	1		0.011		0.027		0.0034		0.0084		3.8		18.2	
7	gtmpinut	01/03/1907 10:22	1	2		0.012		0.017		0.0030		0.0092		5.4		18.2	
8	gtmpcnut	01/03/2007 12:56	1	1		0.020		0.043		0.0032		0.0133		4.0		18.7	
9	gtmpcnut	01/03/2007 12:57	1	2		0.018		0.030		0.0029		0.0127		5.6		18.7	
10	gtmpcnut	01/02/2007 10:30	2	1		0.014		0.036		0.0020							<-1>
11	gtmpcnut	01/02/2007 13:00	2	1		0.022		0.053		0.0038		0.0231		5.8			<-1>
12	gtmpcnut	01/02/2007 15:30	2	1		0.043		0.089		0.0044		0.0323		5.4			<-1>
13	gtmpcnut	01/02/2007 18:00	2	1		0.034		0.060		0.0047		0.0336		3.9			<-1>
14	gtmpcnut	01/02/2007 20:30	2	1		0.040		0.083		0.0045		0.0300		3.7			<-1>
15	gtmpcnut	01/02/2007 23:00	2	1		0.029		0.105		0.0040		0.0259		4.2			<-1>
16	gtmpcnut	01/03/2007 01:30	2	1		0.037		0.070		0.0047		0.0336		2.9			<-1>
17	gtmpcnut	01/03/2007 04:00	2	1		0.050		0.100		0.0045		0.0366		2.4			<-1>
18	gtmpcnut	01/03/2007 06:30	2	1		0.059		0.115		0.0048		0.0349		2.9			<-1>
19	gtmpcnut	01/03/2007 09:00	2	1		0.039		0.099		0.0049		0.0280		5.4			<-1>
20	gtmpcnut	01/03/2007 11:30	2	1		0.019		0.050		0.0026		0.0111		5.4			<-1>
21	gtmpinut	02/19/2007 11:31	1	1		0.014		0.037		0.0020		0.0030		4.5		12.3	
22	gtmpinut	02/19/2007 11:32	1	2		0.011		0.031		0.0009		0.0004		4.2		12.3	
23	gtmpcnut	02/19/2007 14:31	1	1		0.031		0.062		0.0057		0.0218		8.7		11.5	
24	gtmpcnut	02/19/2007 14:32	1	2		0.031		0.048		0.0056		0.0213		8.9		11.5	
25	gtmpcnut	02/18/2007 10:20	2	1		0.038		0.099		0.0061		0.0277		4.0			<-1>

Data | MDL | User Notes | Rejected Data <-3> | Missing Data <-2> | Passed Initial QAQC Checks

Figure 113. Example nutrient data with optional field parameter

12) Once all the data are entered, you must set the significant digits appropriate for reporting each parameter. Step 4: Set Significant Digits

The **Set Significant Digits** tool will allow you to easily set the number of significant digits to the right of the decimal place to report each parameter to and automatically round the data using banker's rounding rules. Banker's rounding rules determine when to drop a .5 or round up to the next even number and are used to minimize bias due to rounding a .5 in the same direction *(rounding down 4 times, rounding up 5 times)*. Banker's rounding rules round a .5 to the next **even** number. *For example, a 1.5 is rounded to a 2 while a 2.5 is rounded to a 2.* Significant digits must be applied to the measured data prior to any calculations, and then applied to the calculated values to ensure accurate data reporting.

Background on significant figures

Incorrect reporting of directly measured values: The values held in each cell should be reported to the number of decimal places justified by the accuracy of the analysis. Values with more than three or four decimal places for nutrients and one or two decimal places for chlorophyll are purporting analytical accuracies that are not achievable, therefore calculating values from these numbers results in significant error. **Data must be reported to the correct number of decimal places, as justified by the accuracy of the lab analysis. Contact your lab with any questions on reporting accuracy.**

Incorrect rounding of values: Rounding rules need to be followed when reporting data to the correct number of decimal places, particularly the rule for dropping 5's and expressing calculated values to the correct number of significant figures. Excel does not round data according to the significant figures rounding rules in the Standard Methods for the Examination of Water and Wastewater (APHA 1998), instead it uses banker's rounding rules to accomplish the same thing. If a 5 is dropped, the preceding digit is rounded off to the nearest **even** number. **Rounding rules must be applied prior to any calculations.**

Note that using the Format Cells function in Excel is not a correct method for reporting the data accurately. The Format Cells function does not use banker's rounding rules and simply changes how the data are displayed without changing the value itself, which is not in accordance with significant figures rounding rules.

Incorrect reporting of calculated values: Calculated values should not be reported with more decimal places than either of the component values used in that calculation. Excel does not automatically report the correct number of significant figures resultant from a calculation. **If a calculated value is a result of a subtraction or an addition operation, the number with the fewest decimal places establishes the number of significant figures to use.**

Examples:

Incorrect data reporting and rounding:
For example, if a 0.01456921 value is returned from the lab for NO2 on 1/1/2004 @ 12:00pm and you use the Format Cells function in Excel to format the value to 3 decimal places, the ***displayed*** *value will be* ***0.015****. If the corresponding NO23 value returned from the lab is 0.01965427 and you format the value to 4 decimal places using the Format Cells function in Excel, the* ***displayed*** *value will be* ***0.0197****.*

If you went further and calculated NO3 from the values held in Excel, you will end up with the following ***incorrect*** *value, 0.00508506, or* ***0.005*** *after you use the Format Cells function to format the cell to output to 3 decimal places.*

Correct data reporting and rounding:
Using the same example, if a 0.01456921 value is returned from the lab for NO2 on 1/1/2004 @ 12:00pm and you use the Set Significant Digits tool in the NutrientQAQC macro to set the number of significant digits to the right of the decimal place to 3 decimal places, the ***correct result*** *will be* ***0.014****. If the corresponding NO23 value returned from the lab is 0.01965427 and use the Set Significant Digits tool to set the number of significant digits to the right of the decimal place to 4 decimal places, the* ***correct result*** *will be* ***0.0196****.*

Then if you went further and calculated NO3 and used the Set Significant Digits tool in the NutrientQAQC macro to set the number of significant digits to the right of the decimal place to 3 decimal places, you will end up with the following value, 0.0056, rounded to the ***correct*** *value,* ***0.006****.*

1) After saving your work, reopen the **Nutrient QAQC Main Menu** and select **Step 4: Set Significant Digits** to continue.
2) The **Set Significant Digits** window will open.

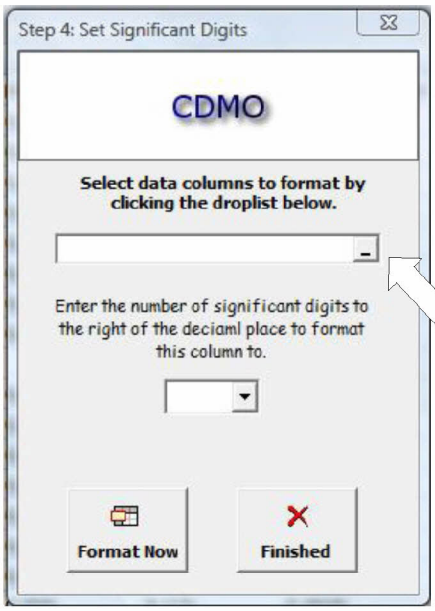
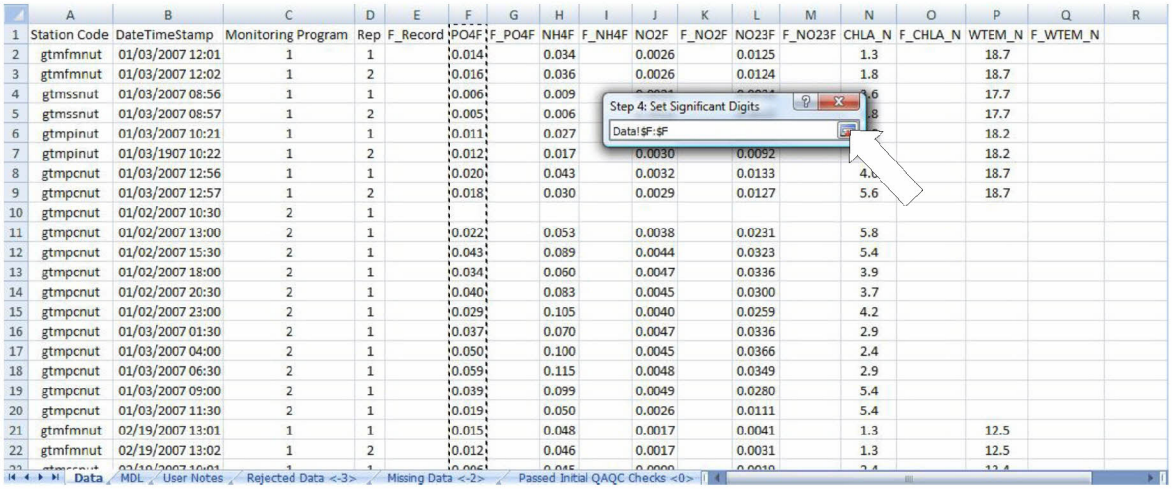


Figure 114. Set significant digits window

3) Minimize the window by clicking on the **Select data columns to format by clicking the droplist below** button.
4) Select the first column of data to set the significant digits then maximize the **Set Significant Digits** window.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record	PO4F	F_PO4F	NH4F	F_NH4F	NO2F	F_NO2F	NO23F	F_NO23F	CHLA_N	F_CHLA_N	WTEM_N	F_WTEM_N	
2	gtmfmnut	01/03/2007 12:01	1	1		0.014		0.034		0.0026		0.0125		1.3		18.7		
3	gtmfmnut	01/03/2007 12:02	1	2		0.016		0.036		0.0026		0.0124		1.8		18.7		
4	gtmssnut	01/03/2007 08:56	1	1		0.006		0.009								17.7		
5	gtmssnut	01/03/2007 08:57	1	2		0.005		0.006								17.7		
6	gtmpinut	01/03/2007 10:21	1	1		0.011		0.027								18.2		
7	gtmpinut	01/03/1907 10:22	1	2		0.012		0.017		0.0030		0.0092				18.2		
8	gtmpcnut	01/03/2007 12:56	1	1		0.020		0.043		0.0032		0.0133				18.7		
9	gtmpcnut	01/03/2007 12:57	1	2		0.018		0.030		0.0029		0.0127		5.6		18.7		
10	gtmpcnut	01/02/2007 10:30	2	1														
11	gtmpcnut	01/02/2007 13:00	2	1		0.022		0.053		0.0038		0.0231		5.8				
12	gtmpcnut	01/02/2007 15:30	2	1		0.043		0.089		0.0044		0.0323		5.4				
13	gtmpcnut	01/02/2007 18:00	2	1		0.034		0.060		0.0047		0.0336		3.9				
14	gtmpcnut	01/02/2007 20:30	2	1		0.040		0.083		0.0045		0.0300		3.7				
15	gtmpcnut	01/02/2007 23:00	2	1		0.029		0.105		0.0040		0.0259		4.2				
16	gtmpcnut	01/03/2007 01:30	2	1		0.037		0.070		0.0047		0.0336		2.9				
17	gtmpcnut	01/03/2007 04:00	2	1		0.050		0.100		0.0045		0.0366		2.4				
18	gtmpcnut	01/03/2007 06:30	2	1		0.059		0.115		0.0048		0.0349		2.9				
19	gtmpcnut	01/03/2007 09:00	2	1		0.039		0.099		0.0049		0.0280		5.4				
20	gtmpcnut	01/03/2007 11:30	2	1		0.019		0.050		0.0026		0.0111		5.4				
21	gtmfmnut	02/19/2007 13:01	1	1		0.015		0.048		0.0017		0.0041		1.3		12.5		
22	gtmfmnut	02/19/2007 13:02	1	2		0.012		0.046		0.0017		0.0031		1.3		12.5		

Figure 115. Select columns

5) Select the number of significant digits to the right of the decimal place to report from the second drop down list. Then click the **Format Now** button to set the significant digits.

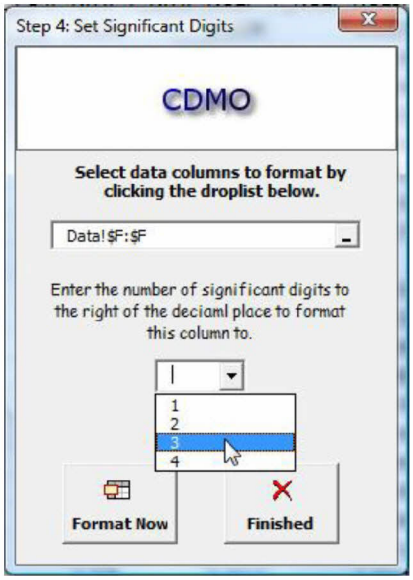


Figure 116. Select significant digits

6) Repeat this process for the remaining measured parameters.

7) Select **Finished** from the **Set Significant Digits** window to return to the **Nutrient QAQC Main Menu**.

8) **Save the Excel workbook** (Step 10) and continue to **Step 5: Enter MDL information**.

IMPORTANT: If you are appending nutrient data to the data sheet as it is received from the lab, or if you make any changes to your data, the Significant Digits will have to be reset each time to include the new data you have entered. This is necessary for proper rounding, ***despite the fact that the data will appear correct due to Excel's display settings***.

Step 5: Enter MDL Information

Method detection limits (MDL) are provided by the laboratory for each measured parameter analyzed. MDLs are a measure of the lowest reliable concentration of an analyte that could be determined with confidence.

1) After saving your work, reopen the **Nutrient QAQC Main Menu** and select **Step 5: Enter MDL Information** to continue.

2) The **MDL Setup** window will open.

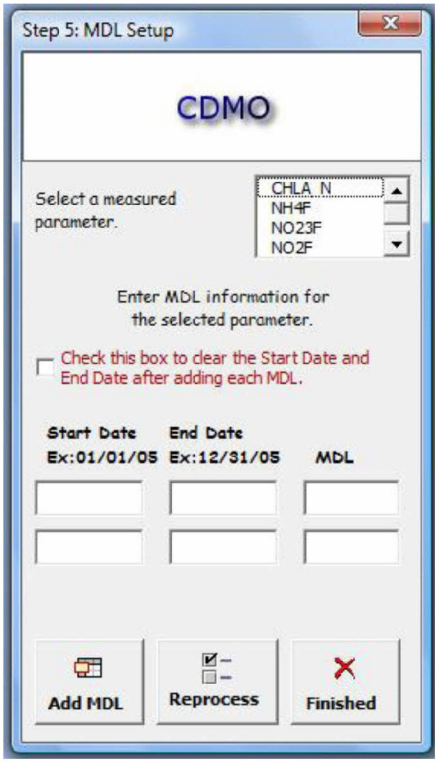


Figure 117. MDL setup window

3) Enter the method detection limit information (dates in use and MDL) for each parameter by first selecting a parameter from the list at the top right of the window. Note that this list will only display the measured parameters in the data sheet.

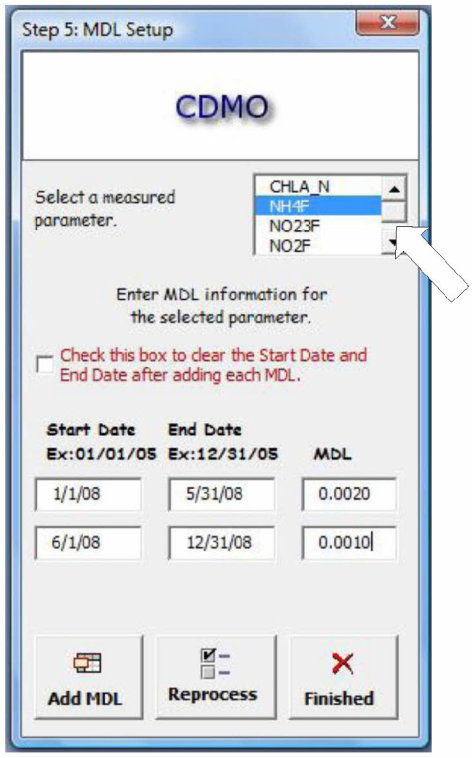


Figure 118. Select parameter

4) After selecting the parameter, enter the range of dates that MDL was used into the **Start Date** and **End Date** boxes.

5) Enter the MDL value in the **MDL** box.

   a. If the lab used two MDLs during the year, enter the first set of dates into the top row and the second set of dates in the bottom row.

   b. You may include more than two MDLs for a parameter, but will have to repeat this process.

6) Click the **Add MDL** button to process the MDLs for the chosen parameter. Data below the MDL will be flagged as **<-3> [SBL]**.

   a. Below MDL data represented with a less than sign (ex: <0.002) will be removed and flagged as **<-3> [SBL]**.

   b. Below MDL data represented by other place holders (*) must be removed and flagged <-3> [SBL] manually with the macro.

7) Repeat the process for the remaining parameters.

8) Select the **Finished** button to return to the **Nutrient QAQC Main Menu**.

9) **Save the Excel workbook** (Step 10) and continue to **Step 6: Set Up Calculated Parameters**.

Reprocessing MDLs

IMPORTANT: If you are appending nutrient data to the data sheet as it is received from the lab, or if you have made changes to your data, the MDLs will have to be reprocessed for the new data to be flagged. To reprocess the MDLs,

1) Open the **MDL Setup** window.

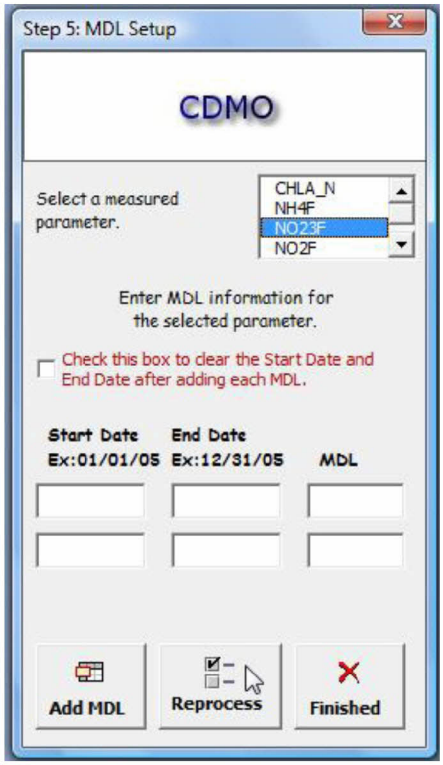


Figure 119. MDL setup window

2) Click the **Reprocess** button. **Note that you do NOT have to re-enter the MDL information as long as the date range you previously entered includes your new or corrected data.** If you need to expand the date range that a MDL covers, you must reenter the dates and MDL.

3) If you need to correct an MDL value, tab to the "MDL" sheet and change the parameter MDL. Reopen the **MDL Setup** window and click the **Reprocess** button.

4) If you need to remove an MDL designation from a parameter completely, tab to the "MDL" sheet and remove the MDL information. Reopen the **MDL Setup** window and click the **Reprocess** button.

5) Select the **Finished** button to return to the **Nutrient QAQC Main Menu**.

Step 6: Set Up Calculated Parameters

A list of parameters available for calculation will be displayed in the **Set Up Calculated Parameters** window. The list and the formulas available are dependent on what measured parameters are present in the data sheet. *For example, if the data sheet contains the measured parameters NH4 and NO23, the calculated parameter DIN will be available for insertion in the dataset.* The user will choose the formula to be used for each calculation.

The Calculated Parameters tool automatically flags calculated values with component values below MDL as **<-3> [SCB]** and negative calculated values with **<-3> [SNV]**. In addition, component values that result in a negative calculated value are automatically flagged **<1> [SCC]**.

IMPORTANT: Steps 4 and 5, which round the data to the correct number of significant digits using banker's rounding rules and process the data for MDLs, **MUST be completed before proceeding to Step 6**. If they are not completed properly, the data will be reported incorrectly and automatic flagging for calculated values will be inaccurate.

1) Select **Step 6: Set Up Calculated Parameters** and the following window will open displaying the calculated parameters available to be included in the dataset. **Note that even though these parameters may not be required, they do provide important additional information about the SWMP stations**.

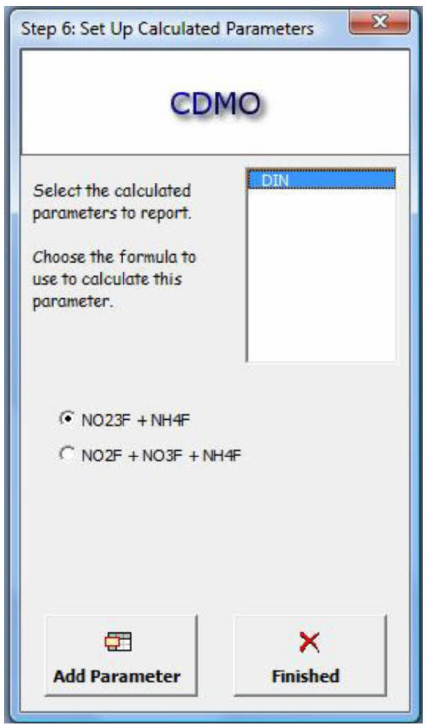


Figure 120. Set Up calculated parameters window

2) Select the calculated parameter from the list.

3) The formula(s) available to perform that calculation will then be displayed. Select the formula to be used then click the **Add Parameter** button for Excel to perform the calculation.

4) Repeat this process for additional calculated parameters.

5) Use the **Set Significant Digits tool** on **each calculated parameter column** to report the data to the correct number of significant digits.

IMPORTANT: The Set Up Calculated Parameters tool does not automatically round the calculated parameter to the correct number of significant digits for you, therefore you will have to use the Set Significant Digits tool for each calculated parameter. If the component values are reported to different decimal places, the component parameter with the fewest decimal places determines the number of decimal places to be applied to the calculated value.

In the figure below, NO23F is reported to four decimal places while NH4F is reported to three decimal places. For the DIN value to be correct, it cannot be reported to more than three decimal places because one of its components, NH4F, was only reported to three decimal places.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record	PO4F	F_PO4F	NH4F	F_NH4F	NO2F	F_NO2F	NO23F	F_NO23F	NO3F	F_NO3F	DIN	F_DIN	CHLA_N
2	gtmfmnut	01/03/2007 12:01	1	1		0.014		0.034		0.0026		0.0125		0.0099		0.0465		1.3
3	gtmfmnut	01/03/2007 12:02	1	2		0.016		0.036		0.0026		0.0124		0.0098		0.0484		1.8
4	gtmssnut	01/03/2007 08:56	1	1		0.006		0.009		0.0021		0.0034		0.0013		0.0124		3.6
5	gtmssnut	01/03/2007 08:57	1	2		0.005		0.006	<-3> [SBL]	0.0022		0.0022		0		0.0082	<-3> [SCB]	3.8
6	gtmpinut	01/03/2007 10:21	1	1		0.011		0.027		0.0034		0.0084		0.005		0.0354		3.8
7	gtmpinut	01/03/1907 10:22	1	2		0.012		0.017		0.0030		0.0092		0.0062		0.0262		5.4
8	gtmpcnut	01/03/2007 12:56	1	1		0.020		0.043		0.0032		0.0133		0.0101		0.0563		4.0
9	gtmpcnut	01/03/2007 12:57	1	2		0.018		0.030		0.0029		0.0127		0.0098		0.0427		5.6
10	gtmpcnut	01/02/2007 10:30	2	1		0.014		0.036		0.0020					<-2> [GCM]		<-2> [GCM]	
11	gtmpcnut	01/02/2007 13:00	2	1		0.022		0.053		0.0038		0.0231		0.0193		0.0761		5.8
12	gtmpcnut	01/02/2007 15:30	2	1		0.043		0.089		0.0044		0.0323		0.0279		0.1213		5.4
13	gtmpcnut	01/02/2007 18:00	2	1		0.034		0.060		0.0047		0.0336		0.0289		0.0936		3.9
14	gtmpcnut	01/02/2007 20:30	2	1		0.040		0.083		0.0045		0.0300		0.0255		0.113		3.7
15	gtmpcnut	01/02/2007 23:00	2	1		0.029		0.105		0.0040		0.0259		0.0219		0.1309		4.2
16	gtmpcnut	01/03/2007 01:30	2	1		0.037		0.070		0.0047		0.0336		0.0289		0.1036		2.9
17	gtmpcnut	01/03/2007 04:00	2	1		0.050		0.100		0.0045		0.0366		0.0321		0.1366		2.4
18	gtmpcnut	01/03/2007 06:30	2	1		0.059		0.115		0.0048		0.0349		0.0301		0.1499		2.9
19	gtmpcnut	01/03/2007 09:00	2	1		0.039		0.099		0.0049		0.0280		0.0231		0.127		5.4
20	gtmpcnut	01/03/2007 11:30	2	1		0.019		0.050		0.0026		0.0111		0.0085		0.0611		5.4
21	gtmpinut	02/19/2007 11:31	1	1		0.014		0.037		0.0020		0.0030		0.001		0.04		4.5
22	gtmpinut	02/19/2007 11:32	1	2		0.011		0.031		0.0009	<1> [SCC]	0.0004	<1> [SCC]	-0.0005	<-3> [SNV]	0.0314		4.2
23	gtmpcnut	02/19/2007 14:31	1	1		0.031		0.062		0.0057		0.0218		0.0161		0.0838		8.7
24	gtmpcnut	02/19/2007 14:32	1	2		0.031		0.048		0.0056		0.0213		0.0157		0.0693		8.9

Data | MDL | User Notes | Rejected Data <-3> | Missing Data <-2> | Passed Initial QAQC Checks <0>

Figure 121. Calculated data

Note the automatic flagging that occurred during the calculate parameters process:

DIN value calculated from NH4F value that is below MDL automatically flagged and coded

NO3F and DIN values calculated from missing components are flagged as <-2> [GCM] and cells are left empty

NO3F negative calculated value and components automatically flagged

6) Select the **Finished** button to return to the **Nutrient QAQC Main Menu**.

7) **Save the Excel workbook** (Step 10) and continue to **Step 7: Create Charts**.

IMPORTANT: If you are appending nutrient data to the data sheet as it is received from the lab, or make changes to the data, the calculated parameters will have to be regenerated each time you add additional data and the significant digits reset. Simply delete the calculated parameter columns and repeat Step 6: Set Up Calculated Parameters. You may choose to only add your calculated parameters after receiving and compiling a complete year of data.

Step 7: Create Charts

The **Create Charts** tool will allow you to easily create plots of any parameter in the data sheet. The user has the flexibility to plot data from multiple stations, sampling programs (diel or grab) and parameters.

1) After saving your work, reopen the **Nutrient QAQC Main Menu** and select **Step 7: Create Charts**.

2) The **Create Charts** window will open.

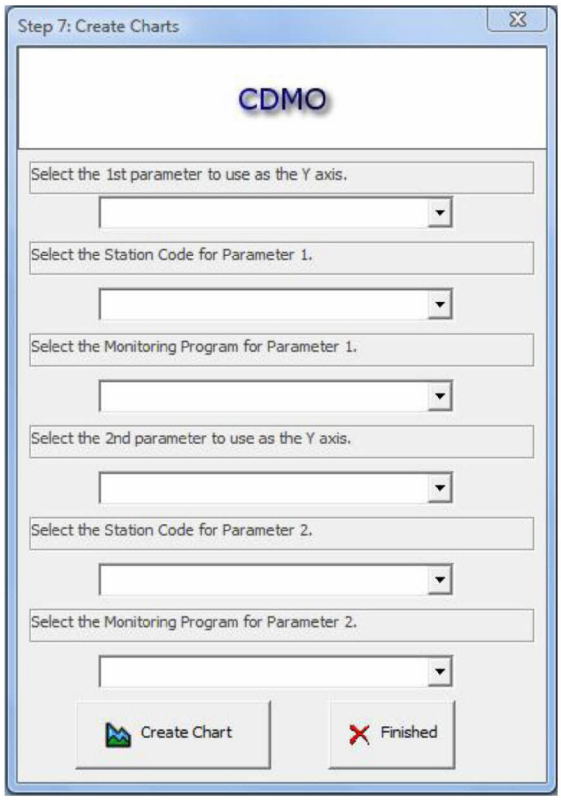


Figure 122. Create charts window

3) **To plot one data series,**

   a. Select the first parameter to chart from the first drop down list.

   b. Select the station for the first parameter by choosing the station code from the second drop down list.

   c. Select the monitoring program for the first parameter from the third drop down list. (Monthly grab samples = 1 and monthly diel samples = 2).

   d. Leave the rest of the drop down lists blank and select the **Create Chart** button. A new tab will be created in the Excel workbook containing the filtered data and the chart. The chart will be located at the top of the worksheet. The macro will name the worksheet automatically based on the station code, monitoring program code, and parameter chosen for the chart.

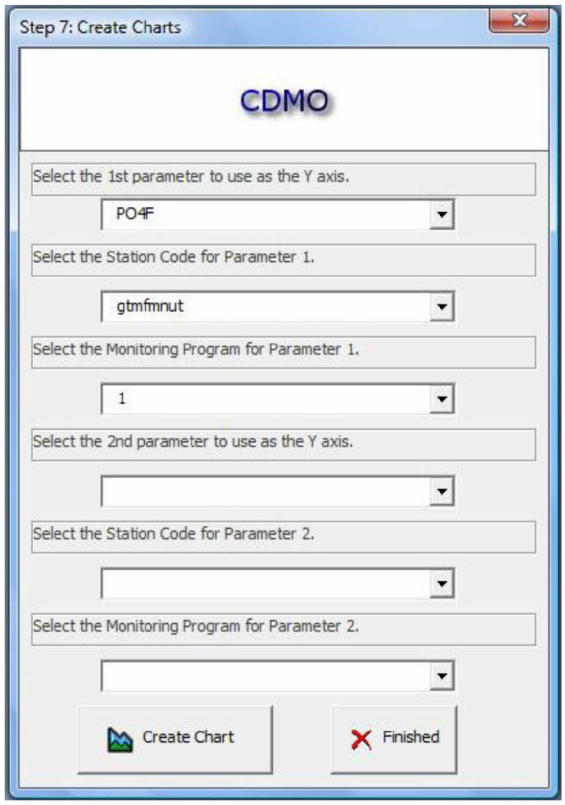


Figure 123. Create charts window

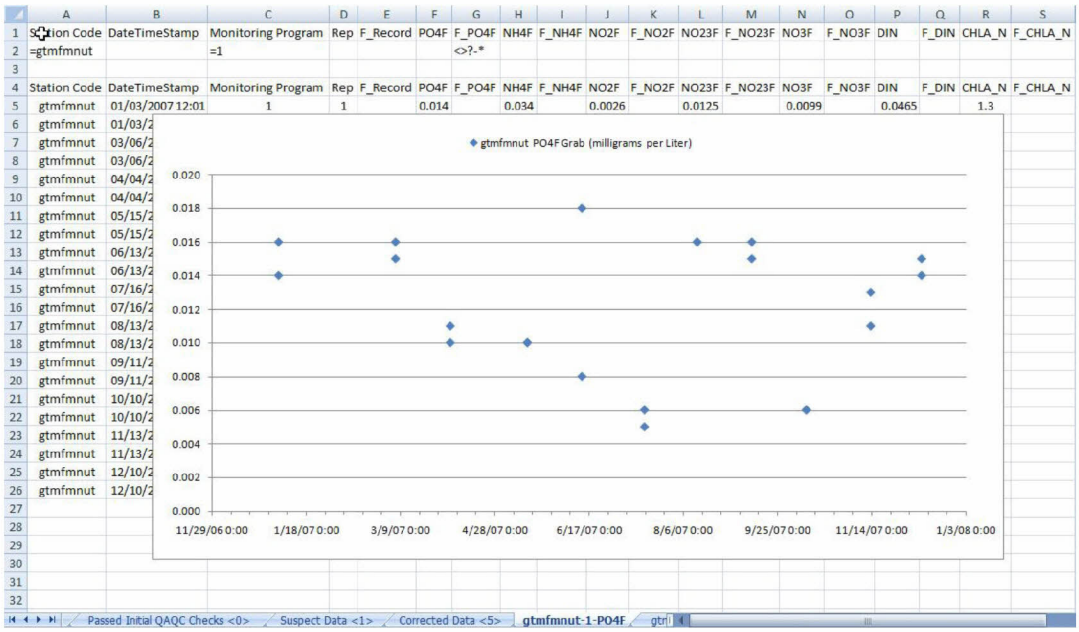


Figure 124. Single data series chart

e. You may need to make some minor formatting changes to your charts in order to view them better. The macro cannot format charts perfectly in multiple versions of Excel. In the

following chart, the legend has been moved to the top of the chart (click on the legend and drag it to the desired location) and the x-axis dates have been rotated (right click on the x-axis, choose format axis, choose alignment, select horizontal for text direction). The chart itself can also be resized by selecting the chart (inside the window), "grabbing" a corner, and moving it until the appropriate size has been reached.

4) **To plot two data series,**

a. Select the first parameter to chart from the first drop down list.

b. Select the station for the first parameter by choosing the station code from the second drop down list.

c. Select the monitoring program for the first parameter from the third drop down list. (Monthly grab samples = 1 and monthly diel samples = 2).

d. Select the second parameter to chart from the fourth drop down list. You can choose the same parameter or a different one.

e. Select the station for the second parameter by choosing the station code from the fifth drop down list. You can choose the same station or a different one.

f. Select the monitoring program for the second parameter from the sixth drop down list.

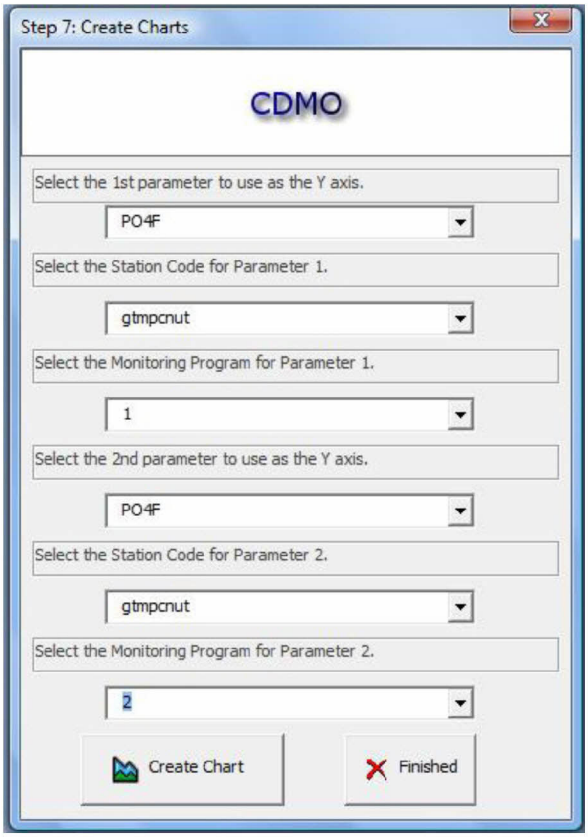


Figure 125. Create charts window

5) Select the **Create Chart** button to plot the data. A new tab will be created in the Excel workbook containing the filtered data and the chart. The chart will be located at the top of the worksheet. The

macro will name the worksheet automatically based on the station codes, monitoring program codes, and parameters chosen for the chart.

Figure 126. Dual series chart

IMPORTANT: Charts will have to be regenerated each time you add data to the data sheet or apply any -3 QAQC flags to the dataset. In order to stay better organized, you should delete obsolete chart worksheets before regenerating new ones (right-click on chart tab and choose delete).

6) Repeat this process for the remaining parameters.

7) Once all charts have been created, close the **Create Charts** window and the **Nutrient QAQC Main Menu** then review each chart individually.

8) **Save the Excel workbook** (Step 10).

9) After all parameters have been graphed, inspect each one and note any questionable data. Mouse over the chart to determine dates/times and data values for problem areas.

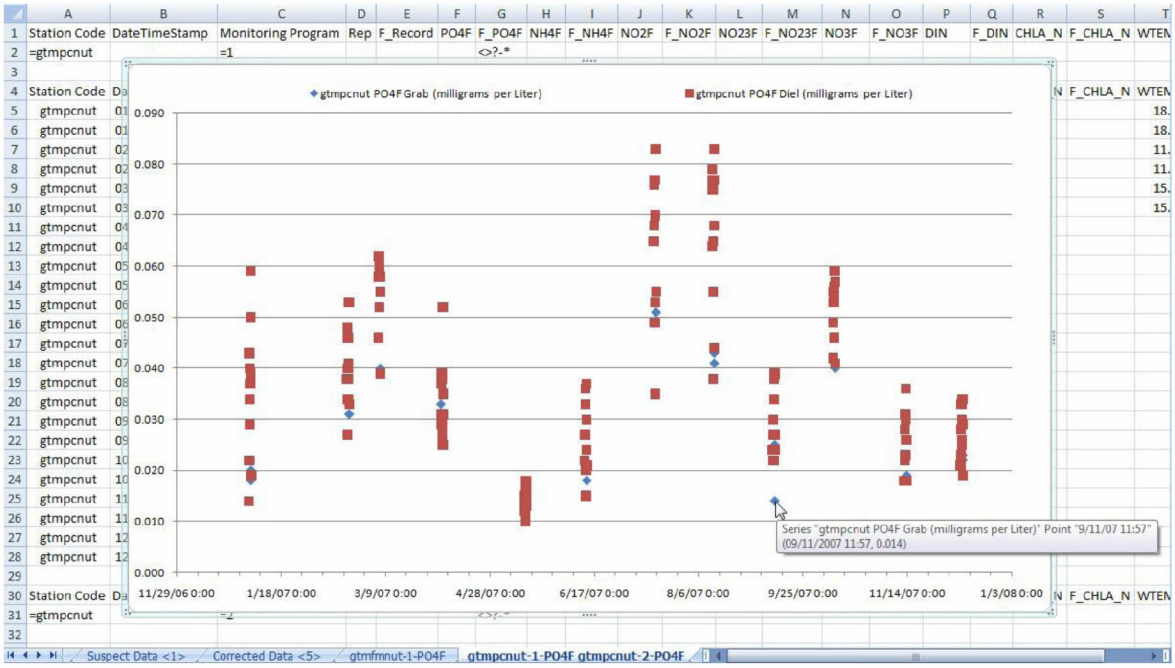


Figure 127. Questionable data

10) Once all questionable data have been identified, continue to the next step, applying flag codes to the data.

Step 8: Apply Flag Codes

The **Apply Flag Codes tool** will allow the user to document the data by inserting QAQC flags and codes into the parameter flag columns of the dataset.

To launch the **Apply Flag Codes** tool,

1) Click on the **Step 8: Apply Flag Codes** button from the **Nutrient QAQC Main Menu**.

2) The **Apply Flag Codes** window will open.

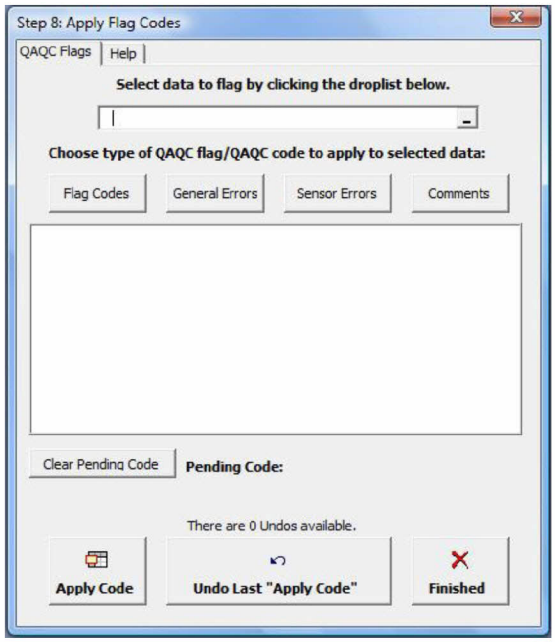


Figure 128. Apply flag codes window

Apply QAQC flags and QAQC codes to data

The **Apply Flag Codes** tool will facilitate the documentation of the data through the use of QAQC flags and codes. Remember that the QAQC flags and codes that you enter into the dataset act as metadata; therefore be as thorough as possible when choosing a QAQC flag and QAQC code(s) to apply. The data can always be further documented in the metadata document through the use of the **CSM see metadata** QAQC comment code.

The user will **choose the type of QAQC flag and QAQC code to apply to the selected data** from the following buttons: **Flag Codes**, **General Errors**, **Sensor Errors** and **Comments**. Refer to the QAQC flags and QAQC codes sections for a list of flags and codes to choose from, then choose the most appropriate to apply to the data.

Considerations before applying QAQC flags and codes

The **record flag column** may contain multiple record comment codes and should be utilized to describe conditions at the time of sample collection and provide any other information that applies to the entire record.

Remember that **each QAQC flag applied must be accompanied by at least one QAQC code, but only one QAQC flag and two QAQC codes are allowed per value.** A general error code cannot be used in combination with a sensor error code and vice versa. However, a comment code can be used in addition to a general error or sensor error code.

When selecting the data, remember that the parameter column and its associated flag column can be selected, rather than just the flag column itself. **QAQC flags and codes will only be entered into the selected flag columns.**

To select contiguous records, select the range of parameter values and their associated flag values.

To select non-contiguous records, select the first parameter value and its associated flag value then hold down the **Ctrl** key to select the remaining parameter and flag values[35]. Please note that there is a limitation with Excel when selecting non-contiguous records so try to flag data in small increments this way.

Remember that **General Error** codes are typically applied to an entire record while **Sensor Error** codes are typically applied to the affected sensor only. To further document the value, a **Comment** code can also be applied.

Applying QAQC flags and codes

1) **Review charts for trends and outliers:** Refer to the charts you created to diagnose problems.

2) When you are ready to document the flagged data with the appropriate QAQC flag or QAQC code, select **Step 8: Apply Flag Codes** from the **Nutrient QAQC Main Menu**.

3) **Apply secondary QAQC flags and codes:** With the **Apply Flag Codes** window open, select the data to flag by clicking on the minimize button in the **Select data to flag by clicking the droplist below** window shown in the figure below.

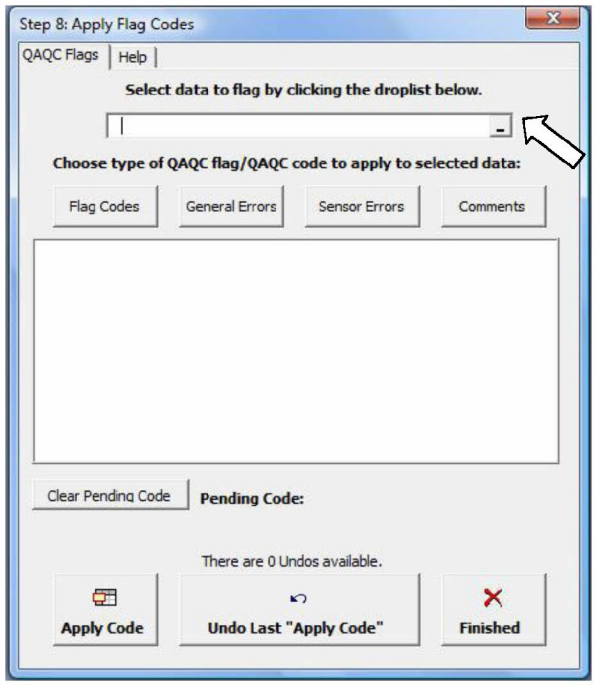


Figure 129. Select data to flag

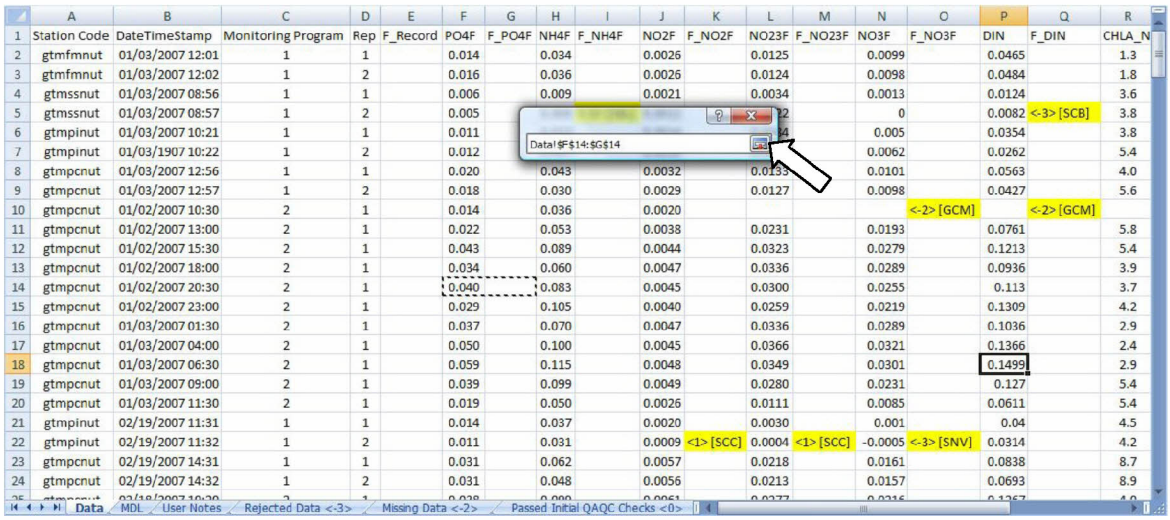
4) The **Apply Flag Codes** window will collapse and leave the following data selection window open.

[35] This technique must be used when using the Autofilter function.

Figure 130. Data selection window

5) Select the data to flag in the "Data" sheet, then maximize the data selection window to return to the **Apply Flag Codes** window.

IMPORTANT: Note that unlike flagging with the NERRQAQC macro, you can only flag data in the "Data" sheet and not the metadata sheets.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Station Code	DateTimeStamp	Monitoring Program	Rep	F_Record	PO4F	F_PO4F	NH4F	F_NH4F	NO2F	F_NO2F	NO23F	F_NO23F	NO3F	F_NO3F	DIN	F_DIN	CHLA_N
2	gtmfmnut	01/03/2007 12:01	1	1		0.014		0.034		0.0026		0.0125		0.0099		0.0465		1.3
3	gtmfmnut	01/03/2007 12:02	1	2		0.016		0.036		0.0026		0.0124		0.0098		0.0484		1.8
4	gtmssnut	01/03/2007 08:56	1	1		0.006		0.009		0.0021		0.0034		0.0013		0.0124		3.6
5	gtmssnut	01/03/2007 08:57	1	2		0.005						2		0		0.0082	<-3> [SCB]	3.8
6	gtmpinut	01/03/2007 10:21	1	1		0.011						4		0.005		0.0354		3.8
7	gtmpinut	01/03/1907 10:22	1	2		0.012								0.0062		0.0262		5.4
8	gtmpcnut	01/03/2007 12:56	1	1		0.020		0.043		0.0032		0.0133		0.0101		0.0563		4.0
9	gtmpcnut	01/03/2007 12:57	1	2		0.018		0.030		0.0029		0.0127		0.0098		0.0427		5.6
10	gtmpcnut	01/02/2007 10:30	2	1		0.014		0.036		0.0020					<-2> [GCM]		<-2> [GCM]	
11	gtmpcnut	01/02/2007 13:00	2	1		0.022		0.053		0.0038		0.0231		0.0193		0.0761		5.8
12	gtmpcnut	01/02/2007 15:30	2	1		0.043		0.089		0.0044		0.0323		0.0279		0.1213		5.4
13	gtmpcnut	01/02/2007 18:00	2	1		0.034		0.060		0.0047		0.0336		0.0289		0.0936		3.9
14	gtmpcnut	01/02/2007 20:30	2	1		0.040		0.083		0.0045		0.0300		0.0255		0.113		3.7
15	gtmpcnut	01/02/2007 23:00	2	1		0.029		0.105		0.0040		0.0259		0.0219		0.1309		4.2
16	gtmpcnut	01/03/2007 01:30	2	1		0.037		0.070		0.0047		0.0336		0.0289		0.1036		2.9
17	gtmpcnut	01/03/2007 04:00	2	1		0.050		0.100		0.0045		0.0366		0.0321		0.1366		2.4
18	gtmpcnut	01/03/2007 06:30	2	1		0.059		0.115		0.0048		0.0349		0.0301		0.1499		2.9
19	gtmpcnut	01/03/2007 09:00	2	1		0.039		0.099		0.0049		0.0280		0.0231		0.127		5.4
20	gtmpcnut	01/03/2007 11:30	2	1		0.019		0.050		0.0026		0.0111		0.0085		0.0611		5.4
21	gtmpinut	02/19/2007 11:31	1	1		0.014		0.037		0.0020		0.0030		0.001		0.04		4.5
22	gtmpinut	02/19/2007 11:32	1	2		0.011		0.031		0.0009	<1> [SCC]	0.0004	<1> [SCC]	-0.0005	<-3> [SNV]	0.0314		4.2
23	gtmpcnut	02/19/2007 14:31	1	1		0.031		0.062		0.0057		0.0218		0.0161		0.0838		8.7
24	gtmpcnut	02/19/2007 14:32	1	2		0.031		0.048		0.0056		0.0213		0.0157		0.0693		8.9

Data! $F$14:$G$14

Data | MDL | User Notes | Rejected Data <-3> | Missing Data <-2> | Passed Initial QAQC Checks <0>

Figure 131. Data selected to flag in the data sheet

6) Select the appropriate QAQC code(s) to apply from the **General Errors**, **Sensor Errors** and/or **Comments** buttons first. As you make a selection, the pending QAQC codes will be displayed next to the **Pending Code:** in the **Apply Flag Codes** window in red font. Remember that you can also apply a parameter **Comment Code** to a **General** or **Sensor Error Code** or use alone.

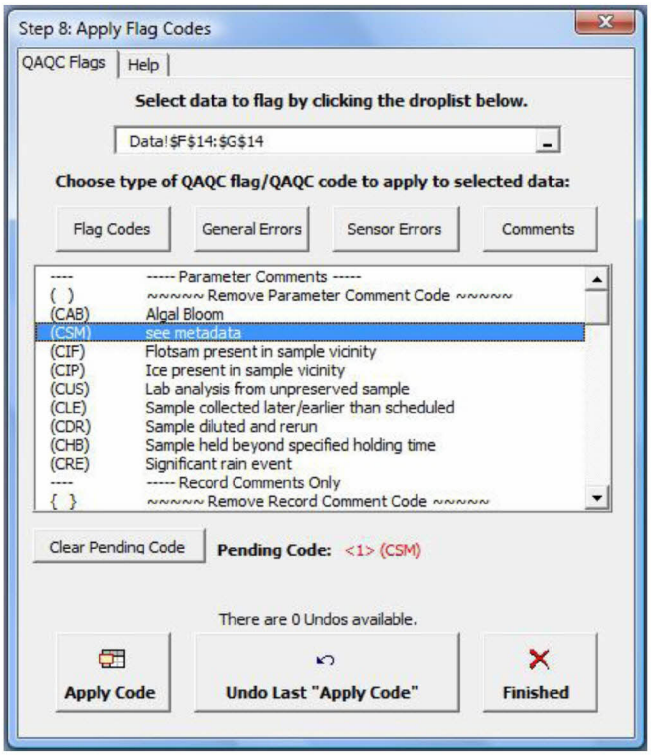


Figure 132. Applying a QAQC code

7) Next select the QAQC flag to apply from the **Flag Codes** button. Remember to:

   Use the **<-3> Data rejected due to QAQC checks** to flag a value that was rejected.

   Use the **<-2> Missing data** to flag missing values.

   Use the **<1> Suspect data** to flag questionable data.

   Use the **<5> Corrected data** to flag a value that was corrected.

8) When you are satisfied with the **Pending Code**, select the **Apply Code** button to have the codes applied to the selected data.

9) If you need to clear the pending code to make another selection before applying, select the **Clear Pending Code** button.

10) When applying multiple record comment codes, you must select the **Apply Code** button after each choice. The **Pending Code** will not retain more than one comment.

11) **Remember to reject any values calculated from a rejected component value.** Apply a -3 flag and code appropriately.

12) Exit the flagging tool by choosing the **Finished** button.

13) **Save the Excel workbook** (Step 10) and continue to **Step 9: Synchronize Metadata Sheets**.

Removing QAQC flags and codes

1) If you need to undo a QAQC flag or QAQC code that was applied, use the **Undo Last "Apply Code"** button. You will see a running total of the amount of "Undo" operations available above the **Undo Last "Apply Code"** button. It will keep track of all flags and codes that were entered into the dataset while the file has been open, however if you close the file or open another file to process, the undo operations will be cleared from memory.

2) If you need to remove existing codes that were applied during a previous QAQC session, choose "**Remove General Error Code**" from the General Errors list, "**Remove Sensor Error Code**" from the Sensor Errors list, or "**Remove Comment Code**" from the Comment Code list of the **Apply Flag Codes** window.

Step 9: Synchronize Metadata Sheets

Use the **Synchronize Metadata Sheets** button to copy all data records with flags and/or codes into the appropriate metadata worksheet to facilitate the QAQC process. Do this by opening the **Nutrient QAQC Main Menu** and choosing the **Step 9: Synchronize Metadata Sheets** button.

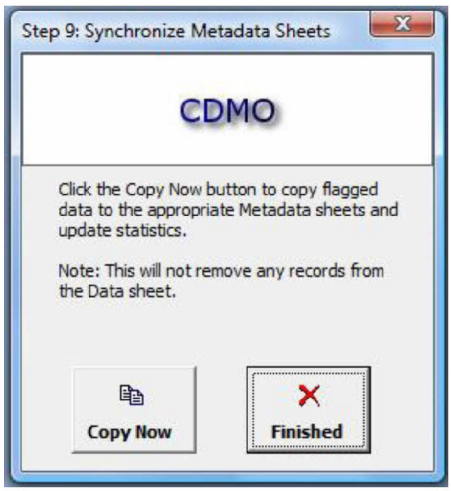


Figure 133 Synchronize metadata sheets

1) Each record containing a flag value will be copied into its respective metadata worksheet.
    a. Entire records are copied to provide full context for QAQC, not just the parameter with the flagged values.

2) The following confirmation window will appear when synchronization is complete.

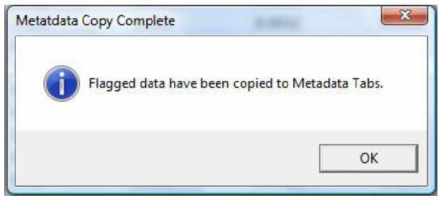


Figure 134. Metadata copy complete

3) Select the **OK** button. A metadata sheet containing summary statistics will either be created or updated at the first tab. Statistics include min, max, average, and standard deviations by station, and exclude all data with QAQC flags less than zero.

   a. Check statistics to verify that all outliers have been addressed.

   b. The statistics tool can also be run independently to either create or update the statistics page at any time.

kacnut2008 [Compatibility Mode]

	A	B	C	D	E	F	G	H	I	J	K	L
1		PO4F	NH4F	NO2F	NO3F	NO23F	DIN	CHLA_N	PHEA	SiO4F		
2	kachsnut											
3	Min	0.0020	0.0060	0.0010	0.0620	0.0650	0.0790	0.2000	0.0400	0.1300		
4	Max	0.0380	0.0280	0.0041	0.1910	0.1940	0.1560	25.6400	3.5100	0.7100		
5	Average	0.0178	0.0169	0.0021	0.1161	0.1156	0.1237	3.8985	0.6293	0.4444		
6	Std Dev	0.0096	0.0066	0.0009	0.0393	0.0368	0.0329	6.8740	0.7942	0.1607		
7												
8	kachdnut											
9	Min	0.0020	0.0070	0.0010	0.0700	0.0750	0.0930	0.1600	0.0500	0.1600		
10	Max	0.0370	0.0360	0.0053	0.1800	0.1830	0.1340	8.1200	1.2600	0.6900		
11	Average	0.0198	0.0221	0.0026	0.1200	0.1230	0.1043	2.3812	0.3921	0.4507		
12	Std Dev	0.0098	0.0105	0.0014	0.0391	0.0343	0.0199	2.6375	0.3493	0.1528		
13												
14	kachhnut											
15	Min	0.0020	0.0060	0.0009	0.0120	0.0460	0.0600	0.1000	0.0200	0.0800		
16	Max	0.0400	0.0430	0.0093	0.2000	0.2010	0.2070	28.3000	2.5100	0.8000		
17	Average	0.0172	0.0163	0.0037	0.1031	0.1186	0.1186	3.1247	0.4587	0.4406		
18	Std Dev	0.0105	0.0078	0.0024	0.0558	0.0424	0.0324	4.9993	0.4665	0.1968		
19												
20	kacssnut											
21	Min	0.0020	0.0070	0.0003	0.0280	0.0290	0.0370	0.1300	0.1400	0.0900		
22	Max	0.0360	0.0120	0.0051	0.2460	0.2470	0.1790	17.4000	1.5600	1.0900		
23	Average	0.0163	0.0092	0.0018	0.1311	0.1335	0.1112	5.1303	0.4495	0.4770		
24	Std Dev	0.0099	0.0016	0.0013	0.0750	0.0602	0.0565	4.8601	0.3721	0.2693		
25												
26	kacsdnut											
27	Min	0.0040	0.0080	0.0009	0.0210	0.0300	0.0490	0.1800	0.0300	0.2400		
28	Max	0.0340	0.0180	0.0052	0.1750	0.2050	0.0510	10.2700	1.7000	0.8200		
29	Average	0.0171	0.0124	0.0022	0.0675	0.1059	0.0500	3.2915	0.4990	0.4312		
30	Std Dev	0.0101	0.0044	0.0013	0.0438	0.0537	0.0010	3.2428	0.4913	0.1468		
31												
32												

Stats | Data | MDL | User Notes | Rejected Data <-3> | Missing

Figure 135. Statistics metadata sheet

4) Use the final **synchronized metadata sheets** to help verify that all necessary QAQC flags are accompanied by at least one QAQC code. Tab through each sheet and look for any QAQC flags or codes that you may have missed.

Step 10: Save as Excel File

Use the **Save as Excel File** button to save the Excel workbook as the final working copy. Do this by opening the **Nutrient QAQC Main Menu** and choosing the **Step 10: Save as Excel File** button. You can always come back to this file to make additional edits if necessary. If desired, the metadata sheets can also be copied and pasted into the Microsoft Word metadata document to be submitted with the finalized data to the CDMO.

1) Save the file to a separate folder reserved for working QAQC files.

   a. If this is your working file for the entire year, use the naming convention required for submission – 3 letter reserve code, data type code, and 4 digit year. For example: "gtmnut2008".

   b. If this is a partial file, use a naming convention that distinguishes the data included in the file and includes the QC designation. For example: "gtmnut01-03.2008_QC"

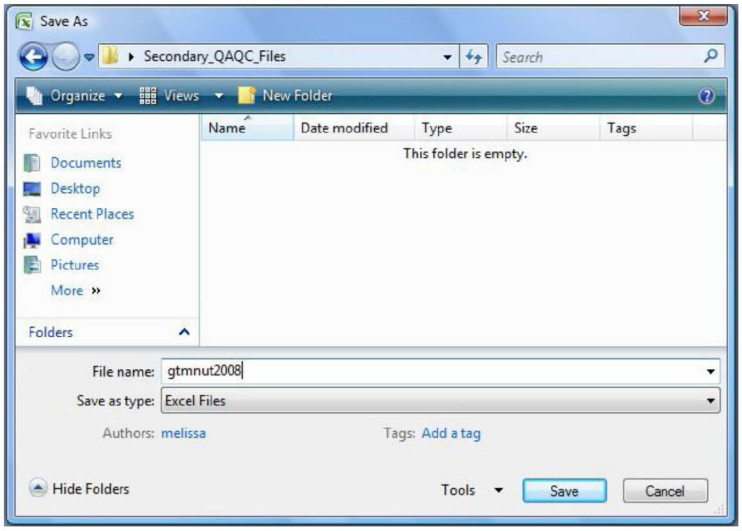


Figure 136. Save as Excel file

Step 11: Export CSV File

This step is only necessary if you would like to export a .CSV file for distribution or your own use. The CDMO will release an upload tool for .CSV nutrient files at a later date.

Remember that once exported, the .CSV file cannot be edited further with the NutrientQAQC macro. If you need to edit the data, you must go back to the final working Excel data workbook to make edits, then re-export the file.

1) When you are ready to export the secondary QAQC'd file as a comma delimited **.CSV** file, choose the **Step 11: Export CSV File** button from the **Nutrient QAQC Main Menu**.

2) Save the file to a separate folder reserved for exported data files. When naming the file, add "**_export**" at the end of the filename to easily identify it. For example, if the file is called "gtmnut2008.XLS" rename the file as "gtmnut2008_export.CSV".

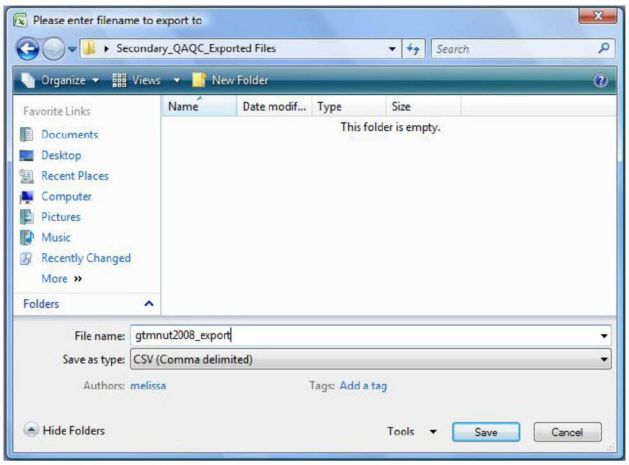


Figure 137. Export .CSV file

Appending secondary QAQC files for final review

If you chose to work with multiple workbooks to process nutrient data as you received it from the laboratory, all your secondary QAQC'd files must be appended into one yearly file and submitted to the CDMO in .XLS format. The easiest method for accomplishing this is to simply copy and paste your data and MDL information into the final yearly Excel workbook.

Before appending files together, you must ensure each file has the same output order and parameters. If they do not, open each file in Excel and shift the columns so that the order is consistent between files, then resave each one.

When pasting data into your final .XLS workbook, be sure to include the column headers. Verify that your parameter columns match before deleting the header row.

Remember to copy your MDL information from the QAQC'd file into the final .XLS workbook MDL metadata sheet.

Final review of appended secondary QAQC files

Once you have appended the secondary QAQC'd files into one yearly file, reopen it in the **NutrientQAQC macro** for final review and charting.

1) Chart each parameter with the **Step 7: Create Charts** tool.

2) Apply additional QAQC flags or QAQC codes to the data with the **Step 8: Apply Flag Codes** tool.

3) Synchronize the metadata and data sheets and update statistics using the **Step 9: Synchronize Metadata Sheets** tool.

4) Save the entire workbook in **.XLS** format using the **Step 10: Save as Excel File** tool.

Frequently asked questions

Q: Do all flagged data need to have a QAQC code applied?
A: ***All data flagged as -3, 1, or 5 must have a QAQC code.*** *Choose the most appropriate QAQC code to apply; a general or sensor error and/or a comment code.*

Q: Why won't the macro let me apply a general error and sensor error code into the same cell?
A: *You must choose to apply either a general error code OR a sensor error code, not both. However a comment code can be used in conjunction with either a general or a sensor error code.*

Q: If my data contains less than signs denoting values below MDL (<0.002), what do I do?
A: *Process your data using the MDL tool as you would normally. The less than signs and values will be removed and the <-3> [SBL] flag and code will be applied automatically.*

Q: If my data contains -9999s or blanks from the lab where values below the MDL were recorded, what do I do?
A: *You should leave those cells blank and flag them with the -3 SBL QAQC flag and code.*

Q: How do I handle values calculated with a rejected component value?
A: *You must reject any values calculated with a rejected component value. Flag the calculated value with a -3 and use general code GCR "Calculated value could not be determined due to rejected data". You may use an additional comment code if desired.*

Nutrient metadata management: metadata documentation

The most important part of data collection is creating the associated data documentation or metadata. Metadata explains all aspects of the data from the research objectives to the data QAQC and should be created as each data set is processed.

The Microsoft Word metadata document that must accompany the dataset will no longer require the missing, suspect or deleted data sections. Because the new QAQC process embeds QAQC flags and codes into the dataset, the metadata document will instead contain a list of all QAQC flags and codes used in the dataset. However, there will be a section available in the metadata to document the dataset in detail if a Reserve wishes, particularly where a **CSM see metadata** QAQC code was used or to copy any of the flagged data information from the NutrientQAQC macro. Reserves must use the 2008 metadata template for 2008 data submission.

Nutrient metadata tips

1) The CDMO will not accept any final yearly data submitted without the corresponding metadata.

2) Metadata must document one calendar year of data. Include all nutrient sites in one metadata file for each year. Be sure to include any changes to the deployment protocol, maintenance, or site changes with a date that the change occurred.

3) Use the data type code to indicate what type of data the metadata refers to. There are currently three data types: **wq** to indicate water quality data, **met** to indicate meteorological data, and **nut** to indicate nutrient data.

4) Name the metadata document using the filename code that indicates the NERR site and what months and year the metadata document covers. (For example, if the metadata filename is acenut01-12.08m, it tells the CDMO that the file is a water quality metadata file for the ACE NERR and covers the months of January - December of 2008).

5) List at the top of the metadata document (under the Title) the months that the metadata covers. List the date of the **Latest Update** to the metadata documentation. Every time that the metadata is edited, the date that the last edit took place should be updated at the top of the metadata record.

6) Save the metadata file as a **Microsoft Word document** before sending to the CDMO server.

7) Make sure to transfer the metadata file as binary if using FTP client software.

Nutrient metadata template
Reserve Name (include 3 letter code here) **NERR Nutrient Metadata**
Months and year the documentation covers
Latest Update: Date that the last edits were made

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons – List the Reserve staff members responsible for the implementation and collection of the nutrient data. List the Laboratory staff members responsible for processing of the samples and data output. Include name, title, mailing address, phone number, and email address for the Research Coordinator, SWMP technician(s), person(s) responsible for data management, and laboratory contact.

2) Research objectives – Describe briefly the nature of the monitoring program resulting in this data set (monitoring along land use, vertical, salinity or habitat gradients).

a) Monthly Grab Sampling Program
b) Diel Sampling Program (mention if samples were taken over a lunar day)

3) Research methods – Detail the specifics of sample collection, collection intervals, sample processing, QAQC of the equipment and analyzers.

a) Monthly Grab Sampling Program
b) Diel Sampling Program

4) Site location and character – Describe your NERR site in general and the sampling sites associated with each YSI data logger / nutrient collection. Include the following in your description for each sampling location. If certain characteristics apply to all sample sites or the entire Reserve they may be discussed in an overview:

a) latitude and longitude
b) tidal range
c) salinity range
d) type and amount of freshwater input
e) water depth (mean depth or depth range at site, NOT depth of sonde deployment)
f) bottom habitat or type (soft sediment, grassbed, oyster bar, etc)
g) pollutants in area
h) description of watershed draining site

5) Coded variable definitions – Explain the station code names and monitoring program codes. For example:
cbvtcnut = Chesapeake Bay Virginia Taskinas Creek nutrients
monthly grab sample program = 1
diel grab sample program = 2

6) Data collection period – List the date and time each sample was collected (include start and end times). Specify the date that SWMP nutrient monitoring first began for each monitoring site.

7) Associated researchers and projects (link to other products or programs) **–** Describe briefly other research (data collection) that correlates or enhances the nutrient data. At a minimum, mention the SWMP MET and WQ datasets.

8) Distribution – This section will address data ownership and data liability by including the following excerpt from the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program in the metadata.

> NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Also include the following excerpt in the metadata which will address how and where the data can be obtained.

> NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format.

II. Physical Structure Descriptors

9) Entry verification – This section explains how data acquisition, data entry, and data verification (QAQC) were performed before data were sent to the CDMO to be archived into the permanent database. Describe how your Reserve receives data from the analytical laboratory, how it is entered into Excel, and how it is verified. If your Reserve converts nutrient values to attain the required units of measurement, note that here and detail your process. List who was responsible for these tasks and include the following statement:

> Nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker's rounding rules; allows the user to input MDL values and automatically flags/codes values below MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

Example of conversion documentation: The University of Washington Marine Chemistry Laboratory calculates and reports results in µM. For purposes of consistency in the NERR System, Padilla Bay NERR calculates the concentrations as mg/ l-1 based on atomic weights of 14.01, 30.97, 28.09, and 12.01 for N, P, Si, and C respectively. Therefore, Padilla Bay NERR staff multiplies the concentrations reported by the University of Washington Marine Chemistry Laboratory by 0.01401, 0.03097, 0.02809, and 0.01201 to yield concentrations in mg/L as N, P, Si, and C respectively.

10) Parameter titles and variable names by category

Required NOAA/NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisks "*". Only list those parameters that are reported in the data. See Table 2 in the "Nutrient and Chlorophyll Monitoring Program and Database Design" SOP version 1.4 (January 2010) for a full list of available parameters.

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus and Nitrogen:			
	*Orthophosphate	PO4F	mg/L as P
	*Ammonium, Filtered	NH4F	mg/L as N
	*Nitrite, Filtered	NO2F	mg/L as N
	*Nitrate, Filtered	NO3F	mg/L as N
	*Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	Dissolved Inorganic Nitrogen	DIN	mg/L as N
Plant Pigments:			
	*Chlorophyll a	CHLA_N	µg/L
	Phaeophytin	PHEA	µg/L
Carbon:			
Other Lab Parameters:			
	Silicate, Filtered	SiO4F	mg/L as SI
Microbial:			
Field Parameters:			
	Water Temperature	WTEM_N	°C

Notes:
1. Time is coded based on a 2400 clock and is referenced to Standard Time.
2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3.

11) Measured or calculated laboratory parameters – This section lists all measured and calculated variables. Only list those parameters that are collected and reported. See Table 2 in the "Nutrient and Chlorophyll Monitoring Program and Database Design" SOP version 1.4 (January 2010) document for a full list of directly measured and computed variables.

a) **Parameters measured directly**

Nitrogen species:	NH4, NO2, NO23
Phosphorus species:	PO4F
Other:	CHLA, PHEA, SiO4, WTEM

b) **Calculated parameters**

NO3	NO23-NO2
DIN	NO23+NH4

12) Limits of detection – This section explains how the laboratory determines the minimum detection limit (MDL). List the method detection limits used and dates they were in use. You may copy this data from the MDL sheet created in the NutrientQAQC macro.

Example: Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, have been established by the VIMS Nutrient Analytical Laboratory. The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample. These values are reviewed and revised periodically.

Parameter	Start Date	End Date	MDL
PO4F	1/1/07	5/31/07	0.0006
PO4F	6/1/07	12/31/07	0.0008
NH4F	1/1/07	12/31/07	0.0015
NO2F	1/1/07	12/31/07	0.0002
NO23F	1/1/07	12/31/07	0.0008
CHLA_N	1/1/06	12/31/06	0.02

13) Laboratory methods – This section lists the laboratory and reference method, the method reference, a brief description of method and a brief description of the sample preservation method used for each parameter that is directly determined.

a) **Parameter: NH4F**

VIMS Laboratory Method: *126*
EPA or other Reference Method: *170.1*
Method Reference: *US.EPA 1983. USEPA-600/4-79-020. Method 170.1*
Method Descriptor: *Filtered sample subjected to hypochlorite-phenol…*
Preservation Method: *Samples filtered and stored at 4 °C up to 24 hours.*

b) **Parameter: NO3F**

VIMS Laboratory Method: *142*
EPA or other Reference Method: *167.1*
Method Reference: *US.EPA 1983. USEPA-600/4-79-020. Method 167.1*
Method Descriptor: *Filtered sample subjected to cadmium reduction column…*
Preservation Method: *Samples filtered and stored frozen at –20 °C up to 14 days.*

14) Field and Laboratory QAQC programs – This section describes field variability, laboratory variability, the use of inter-organizational splits, sample spikes, standards, and cross calibration exercises.

a) **Precision**
- i) **Field variability** – List the specific number (10%) of field replicates; describe how replicates are collected: are field replicates split from a single sample or are they true field replicates (successive grab samples).
- ii) **Laboratory variability** – List specific number (10%) of laboratory replicates.
- iii) **Inter-organizational splits** – Specify if samples were split and analyzed by two different labs.

b) **Accuracy**
- i) **Sample spikes** – List the % recovery of field and laboratory samples (% recovery should be 100% under ideal conditions) – cannot be done on samples analyzed directly from filters.

ii) **Standard reference material analysis –** This will result from samples sent out from EPA to each lab.

iii) **Cross calibration exercises** - *CBNERRVA participates in cross calibration exercises. Cross calibration exercises include the Chesapeake Bay Quarterly Split Sample Program and the US EPA Method Validation Studies.*

15) QAQC flag definitions – This section details the primary and secondary QAQC flag definitions. Include the following excerpt:

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

16) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Value calculated with a value that is below the MDL
SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal Bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant Rain Event
CSM	See Metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal Bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant Rain Event
CSM	See Metadata
CUS	Lab analysis from unpreserved sample
Cloud cover	
CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)
Precipitation	
PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow
Tide stage	
TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide
Wave height	
WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters

WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters
Wind direction	
N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest
Wind speed	
WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

17) Other remarks/notes – Use this section for further documentation of the research data set. Include any additional notes regarding the data set in general, circumstances not covered by the flags and comment codes, or specific data that were coded with the CSM "See Metadata" comment code. You may include the metadata worksheets here if so desired. You may also include information on major storms or precipitation events that could have affected the data recorded at the sample sites. Include the following excerpt:

> Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section I, Part 12) of this document. Concentrations that are less than this limit are rejected. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be rejected. In addition, if any of the components used to calculate a variable are below the MDL, or if a calculated value is negative, the calculated variable is rejected. If additional information on missing data or MDLs is needed, contact the Research Coordinator at the reserve submitting the data.

Formatting the nutrient metadata

1) After completing the final version of the metadata documentation, select **Save as** under the **File** menu.

2) In the **File name** subwindow, type in a new filename for the text file. Name the metadata document with the following filename code that indicates the NERR site, the data type and what months and year the metadata document covers: use the three letter NERR site code, **the data type code (nut=nutrient),** the months this metadata covers in two digit numerical code separated by a dash, a period followed by the two digit year code and an "m" to indicate this is a metadata file. Please use all lowercase when naming the file. *For example, if the metadata filename is acenut01-12.07m, it tells the CDMO that the file is a water quality metadata file for ACE NERR and covers the months of January - December of 2007.*

3) In the **Save as type** subwindow, select **Word Document (*.doc)**.

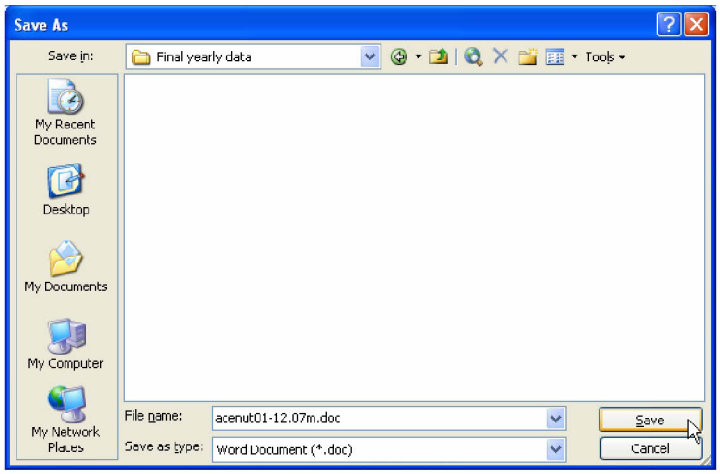


Figure 138. Saving the metadata in Word format.

4) Make sure to select **Binary** in the WS_FTP application before sending to the CDMO.

Nutrient data management: data submission

Submission of final data

Final submission of nutrient data

Reserves must submit the following files to the CDMO by **May 15** of the subsequent year for data submission to be considered complete.

(1) The yearly secondary QAQC Excel Workbook.
(2) The metadata document accompanying the dataset.
(3) The raw files from the analytical laboratory.

Reserves will place these files on the CDMO FTP server (ftp://ftpcdmo.baruch.sc.edu) in the appropriate Reserve's directory. Notify the CDMO when you've completed this process for verification that your submission is complete.

Summary of steps for handling the nutrient files

1) It is most important to virus check all of the files and metadata before sending it to the CDMO FTP server. See Appendix A for recommended virus protection software.

2) Using the **NutrientQAQC macro**, enter the nutrient data into the workbook.

3) Enter the MDL information, set significant digits, calculate parameters and set their significant digits, chart the data and apply QAQC flags and codes as necessary.

4) Save the final yearly file as an **.XLS** file to be submitted to the CDMO server. Place it in the **nutrient/data/edited** directory. Ensure the CDMO file naming convention is used: three letter **Reserve** code, two letter sampling site code, data type code and four digit year.

5) Complete the final yearly metadata file and submit it to the CDMO server by placing it in the **nutrient/metadata** directory. Ensure the CDMO file naming convention is used: three letter **Reserve** code, the data type code, the months the metadata covers in two digit numerical code, followed by the two digit year code and an "m" to indicate this is a metadata file.

6) Submit all raw nutrient data files to the CDMO server by placing them in the **nutrient/data/raw** directory.

7) The process of data acquisition, primary QAQC, secondary QAQC, metadata documentation and data submission is now complete.

Nutrient data management: data archival

Refer to Chapter 1: Preparation for data management for data backup and archival tips. It is recommended to backup and archive the following files created during the QAQC process:

(1) Raw files from the analytical laboratory
(2) *If you used multiple workbooks and appended CSV files:* Secondary QAQC'd **.XLS** component workbook(s)
(3) Yearly Secondary QAQC'd **.XLS** workbook (submitted to CDMO)
(4) Annual metadata **.DOC** file (submitted to CDMO)
(5) Final authenticated XLS workbook (received from the CDMO)
(6) Final authenticated metadata .DOC file (received from the CDMO)

Updating the historical database in EQWin

You can continue to add the final yearly data files to the local historical SWMP database in EQWin. This will serve three purposes:

(1) To backup the data
(2) To keep the local historical database updated
(3) To use EQWin's querying, reporting and exporting tools to satisfy data queries or to use in reports or presentations

If you want to update data to the local historical SWMP data in EQwin, follow these steps and refer to the CDMO NERR SWMP Data Management Manual version 5.2 for detailed instructions on using EQWin software.

1) Open the final QAQC'd **.XLS** file in Excel.
2) You will have to split apart the datetimestamp into a date and a time column.
3) To do this, copy the datetimestamp column, select the next column where you want to copy to and choose **Insert Copied Cells** to copy it. Do this once more so that you will have three datetimestamp columns.
4) Select the second datetimestamp column and format it as **mm/dd/yyyy** from the **Format Cells** menu. Rename that column **"Date"**.
5) Select the third datetimestamp column and format it as **hh:mm** from the **Format Cells** menu. Rename that column **"Time"**.
6) Now delete the first datetimestamp column.
7) Copy the contents of the worksheet.
8) Open the historical EQWin database and paste the data from the altered **.XLS** file into a blank **.EQI** file.
9) Delete the **F_Record** column and all flag columns from the **.EQI** file.
10) Configure the **.EQI** file and set field A2 as **First station code**, set field B2 as **Date collected**, set field C2 as **Time collected**, set field D2 as **Collection Method**, set field E2 as **Sample Class**, and set field F1 as **First parameter code**.
11) Check the data and update it to the database.

Chapter 11

References

American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater, 20th ed. American Public Health Association, Washington, D.C.

Federal Geographic Data Committee. 1994. National Spatial Data Infrastructure Cooperative Program. Program Announcement No. 871. United States Geological Survey. Washington, DC.

National Research Council. 1994. Priorities for Coastal Ecosystem Science. National Academy Press. Washington, DC.

Porter, D.E., W.H. Jefferson, V. Ogburn-Matthews and D.S. Taylor. 1994. Development of an inter-(fill in the blank) database management program for marine resources research and management. Proceedings, Workshop on the Collection and Use of Trawl Survey Data for Fisheries Management. T. Burger (ed.). Special Report No. 35. Atlantic States Marine Fisheries Commission. Washington, DC. pp. 137-144.

Ross, S.W. 2002. A History of the National Estuarine Research Reserve System-wide Monitoring Program. North Carolina National Estuarine Research Reserve.

Appendix A

Internet addresses

The following is a list of web pages for the CDMO, NOAA NERRS and NERR SWMP as well as listings for software that the CDMO has distributed to the NERR sites and other recommended software for use by the NERRS. These web pages provide more information on such topics as troubleshooting, known limitations on the software, and the procedures for registering the software. It is highly recommended that you visit these sites. They contain much more information about the software than the CDMO could include in this manual.

Use these sites to download upgrades. Software upgrades will save the settings and configurations of current software.

Finally, the CDMO highly encourages you to register all software you receive from us, and all software that is downloaded from the Internet. Neither the CDMO nor the University of South Carolina assume any responsibility for loss or damage occurring due to the installation or use of this software.

NERR related

CDMO Online Data Information Server (ODIS) is at: http://cdmo.baruch.sc.edu
CDMO FTP server is at: ftp://cdmo.baruch.sc.edu
CDMO Content Management Site (CMS) is at: http://cdmo.baruch.sc.edu/php_nuke/index.php
NERR SWMP is at: http://nerrs.noaa.gov/Monitoring/welcome.html
NOAA NERR is at: http://nerrs.noaa.gov/welcome.html

PC Software

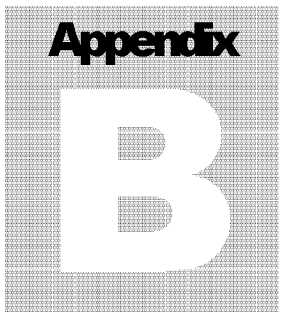
Internet Explorer is at: http://www.microsoft.com/windows/ie/
WS_FTP is at: http://www.ipswitch.com/index.html

Virus Protection

McAfee is at: http://www.mcafee.com/
Norton Antivirus is at: http://www.symantec.com/
Generic Site for virus protection: http://www.antivirus.com

Hardware Vendors

Campbell Scientific is at: http://www.campbellsci.com
YSI is at: http://www.ysi.com



NERR site codes

ACE = Ashepoo Combahee Edisto Basin, South Carolina
APA = Apalachicola Bay, Florida
CBM = Chesapeake Bay, Maryland
CBV = Chesapeake Bay, Virginia
DEL = Delaware
ELK = Elkhorn Slough, California
GND = Grand Bay, Mississippi
GRB = Great Bay, New Hampshire
GTM = Guana Tolomato Mantanzas, Florida
HUD = Hudson River, New York
JAC = Jacques Cousteau, New Jersey
JOB = Jobos Bay, Puerto Rico
KAC = Kachemak Bay, Alaska
MAR = Mission Aransas, Texas
NAR = Narragansett Bay, Rhode Island
NIW = North Inlet-Winyah Bay, South Carolina
NOC = North Carolina
OWC = Old Woman Creek, Ohio
PDB = Padilla Bay, Washington
RKB = Rookery Bay, Florida
SAP = Sapelo Island, Georgia
SFB = San Francisco Bay, California
SOS = South Slough, Oregon
TJR = Tijuana River, California
WEL = Wells, Maine
WKB = Weeks Bay, Alabama
WQB = Waquoit Bay, Massachusetts

Every reserve has a three-letter site code.